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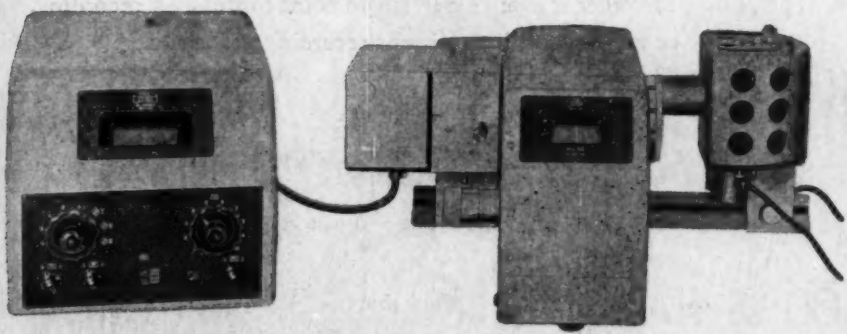

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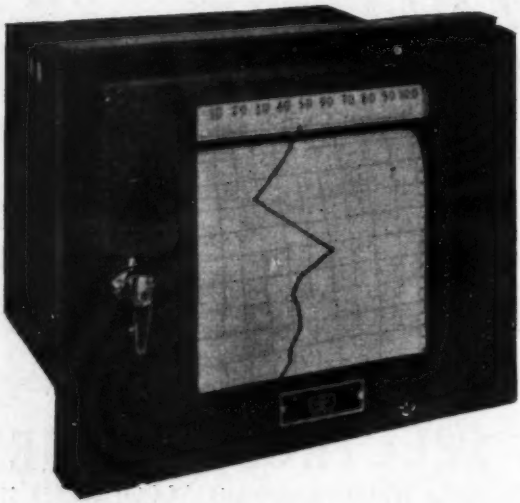

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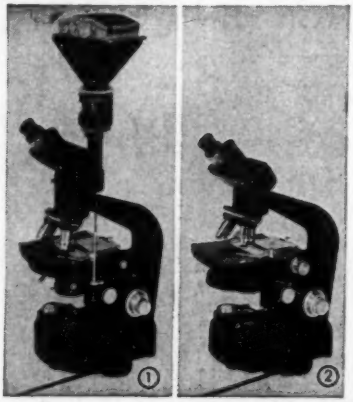

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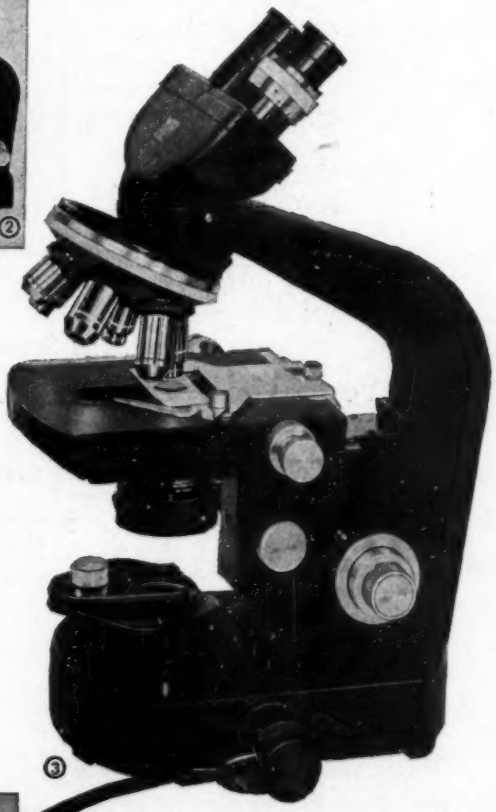

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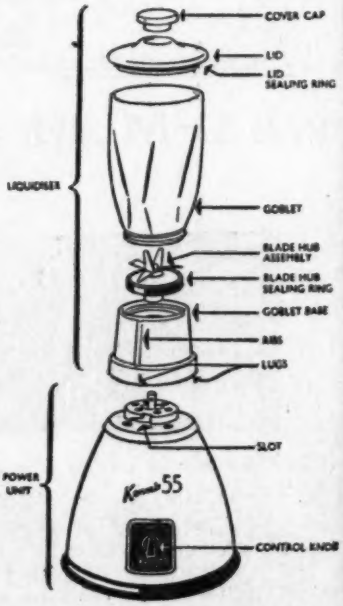

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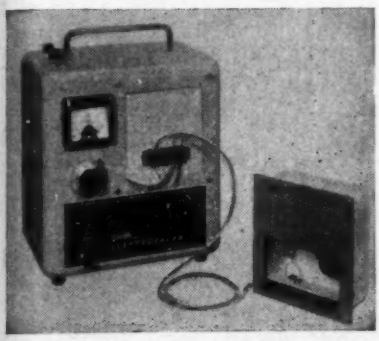

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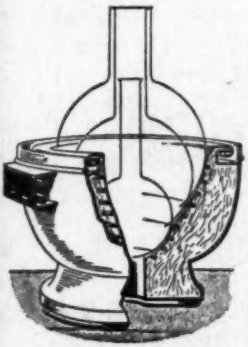

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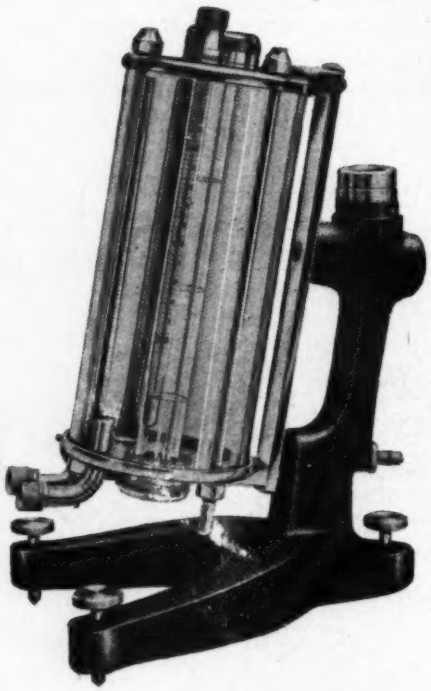

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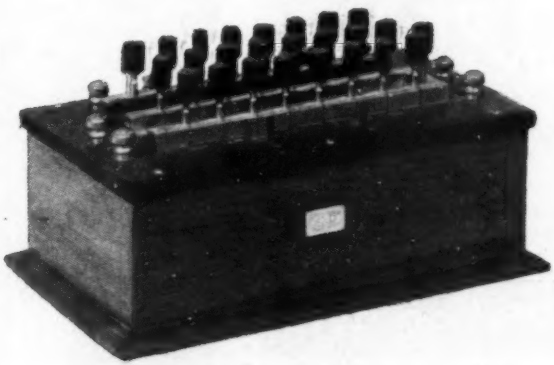

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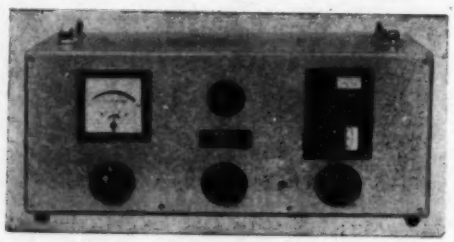

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POLAROGRAPHY*

WHEN nearly 40 years ago Heyrovsky for the first time used the dropping mercury electrode to study electrolytic processes, few could foresee that a versatile analytical technique and an entire science with great potentialities would grow out of it. Today the science of polarography, originally regarded as a narrow branch of electrochemistry, has spread across the fields of industry, biology and medicine, and there is a voluminous literature on the subject comprising literally of tens of thousands of journal articles besides quite a few monographs and standard text-books. The book under review alone contains more than 800 pages and more than 2,000 references.

What is polarography? It is the technique of investigating cathodic phenomena during electrolysis of solutions, and is essentially based on the study of the current-potential curves obtained by using a dropping mercury electrode. It is well known that the use of solid metal electrodes such as platinum, lead, etc., has the disadvantage that the surfaces change during the process, due to deposition or chemical reaction with the products of electrolysis, and as such the results are not reproducible and their interpretation consequently becomes difficult and dubious. The dropping mercury electrode, which is the basis of the success of the polarographic method, consists of a very fine bore (0·04-0·08 mm.) capillary glass tube connected by a flexible tube to an adjustable mercury reservoir. Mercury flows through the tube and tiny drops of mercury are formed (every 2-5 seconds) beneath the surface of the electrolytic solution kept in one of the limbs of the, usually, H-shaped polarographic cell. The anode or the reference electrode is a layer of mercury of large area at the bottom of the other limb. As the applied voltage between the electrodes is increased, electrolysis proceeds on the dropping electrode and the current (of the order of microamps) through the cell is measured with a sensitive galvanometer. In the polarograph devised by Heyrovsky and Shikata, automatic recording of the current-voltage curves is obtained. These curves known as the polarographic curves containing characteristic 'waves' enable one to establish qualitatively and quantitatively the substances which are present in the solution. The value of the potential at which the wave is formed identifies the substances and the height of the wave gives the amount of the substance present in the solution.

The chief advantages of polarographic analysis are (1) it is possible to determine several constituents simultaneously, (2) 0·5 ml. of the solution to be investigated is sufficient and the limits of determination are between 10^{-5} and 10^{-6} M solutions. (3) The polarographic recording takes only 2-8 minutes and on the average a dozen samples can be analyzed per hour. (The time for the preparation of the solution depends on the kind and complexity of the sample, and generally it takes several minutes to one hour.) (4) the method provides a permanent record of the analysis.

The book under review, *Polarography in Medicine, Biochemistry and Pharmacy*, although it is based on the Czech edition of 1952, is not a mere English translation of it but a completely revised and enlarged edition. The new literature, that has accumulated in the intervening years, has necessitated the rewriting of more than half the Czech text. The contributions from Prof. Brdicka and his school have played an important part in this field. The volume comprises of eight parts, each divided into appropriate chapters dealing systematically with the polarographic analysis of related groups of substances.

After a very brief Introductory Chapter which forms Part I of the book, Part II deals with the polarographic determination of inorganic compounds, metal-wise, in different substances, in the organs of the body and in their secretions. Part III, which forms the major bulk of the book, covering as it does about 400 pages, deals with the determination of organic compounds under Quinones, Redox systems, Halogen derivatives, Aldehydes, Ketones, Sugars, Nitrogen compounds, Alkaloids, Vitamins, Hormones, etc. Parts IV and V deal respectively with Proteins and Enzymes. Part VI deals with the analytical applications of Polarographic Maxima. Part VII gives a Table of important Buffers followed by Tables of Half-wave Potentials for ready reference. The Final Part gives the Bibliography, Index of Materials and subject index.

The book is amply illustrated and almost every other page contains the actual polarographic curve for the substance studied. Polarographic cells to be used in special cases

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* *Polarography in Medicine, Biochemistry and Pharmacy*, by M. Brezina and P Zuman. (Interscience Pub., New York.) Pp. xviii + 862. Price $ 19.50.

are also illustrated and described. The book is written in considerable detail so that a polarographer working in the laboratory, or the hospital or in the pharmacy can carry out the analyses without any further reference to the original work. It is indeed an exhaustive laboratory manual which one working in the field could hardly afford to miss. Further, as no single book of comparable quality is available in English, the present edition will bring the subject of Polarography in Medicine and in Biochemistry nearer to a greater number of workers in the field and stimulate further research in this direction.

This English edition, with its excellent printing and get-up, coming as it does on the eve of his 70th birthday, can be regarded as a tribute to the author of Polarography, Academician Jeroslav Heyrovsky. Prof. Heyrovsky not only discovered the polarographic method but also was able to develop it to the full extent of its practical and theoretical application and to set up a school that would continue the development of polarography in the years to come.

The Polarographic Institute at Prague, of which Prof. Heyrovsky is the Director, since its founding in 1950, has been extending polarographic studies into new vistas. The potentialities of employing the oscillograph for the study of electrode reactions proceeding on a single drop of mercury are being examined and Prof. Heyrovsky has succeeded in developing the "Polaroskop" based on oscillographic polarography wherein the presence of reducible or oxidizable substances is signalised by cuts appearing on the oscillographic curves. The depth of the cut indicates the amount of the substance contained in the solution while its position enables one to identify the substance. Another new investigation in oscillographic method in which Prof. Heyrovsky has been working is the "Impulse polarography". In this method polarographic curves are obtained by the application of voltage impulses, and the duration of study will be a matter of few seconds only.

The forthcoming Second International Congress of Polarography to be held in Cambridge in August of this year will focus attention on the recent achievements of Polarography and its applications in Fundamental studies, in Industry and in Biology and Medicine.

India recognized the outstanding importance of the work of Prof. Heyrovsky when the Indian Academy of Sciences elected him as an Honorary Fellow at its last meeting.

MINIATURE GENERATOR POWERED BY RADIOISOTOPES

THE U.S. Atomic Energy Commission, under its project for constructive uses of atomic energy, has developed a miniature Atomic Generator known as the "Radioisotope—fuelled thermo-electric generator". In this device the heat continuously given out by a radioisotope is converted into electricity by use of special semiconductors which act as thermo-couple materials causing flow of current under differential temperature conditions.

The cylindrical generator is 4½ inches wide and 5½ inches high, weighs only 5 lb. and has no moving parts. It is capable of generating five watts of electricity from a 3,000 curie source of Polonium-210. The tiny pellet of fuel is in the centre of the device and is surrounded by 20 pairs of thermo-couples radiating like the spokes of a wheel. The polonium capsule heats itself to more than 700° F. by the energy of disintegration (5·3 Mev., alpha particles). The double-layered spokes are composed of the thermo-electrical material lead telluride that is alloyed with other substances, including bismuth and manganese. Doped semiconductors with their poor heat transmission characteristics have revolutionized the field of old bimetal thermo-couples. When the ends near the source get heated by the continuously radioactive isotope, electric current is set up in each of the thermo-electric spoke and is collected at the rim into a central outlet.

Polonium-210, of half-life 138 days, used as fuel in the model is particularly expensive. But it is intended that later models will use longer lasting and less expensive radioisotopes. One of these is Cerium-144 whose half-life is 290 days, which, if used as fuel, would turn out more power for a longer period of time. Eventually use could be made of radioactive atomic materials now regarded as waste. The weight of the generator could also be reduced to about 3 lb.

The Generator has great potential use as power sources for instruments carried in satellites and space probes on account of its compactness, efficiency and long life. The conventional batteries in the U.S. Atlas satellite [see *Curr. Sci.*, 27 (12), 480] weighed 20 lb. and lasted only for 18 days.—*Atoms for peace Digest.*

BOREHOLE IN THE OCEAN BED

AT the meeting of the International Union of Geodesy and Geophysics held in Toronto in September 1957, plans were made for drilling a deep borehole into the rocks below the earth's crust. The object is to get direct information about the contents, composition, physical state, etc., of the upper mantle of the earth. The mantle itself extends to about half way to the centre of the earth and encloses a core which, the results of seismic wave observations indicate to be fluid and is believed to have a nickel-iron composition.

Our present knowledge of the earth's upper mantle is largely based on reasonable extrapolation carried *downwards* of the results of detailed surface studies, geological and geophysical, of the earth's crust. Recent observations, however, especially on temperatures and heat losses at great depths have thrown doubts on some of these extrapolated findings thus necessitating by more direct means, if possible, a fuller understanding, of the sub-crustal material. It is thought that the sub-crustal material is in a crystalline rather than liquid state and the facts of isostasy show that despite the solid condition of the mantle, it must be capable of flowing under sustained stress.

The crust itself is extremely heterogeneous and complex and it is to be expected that with increasing depth there will be increasing homogeneity in composition and increasing simplicity in the phenomena leading to it. The borehole method will help to get the history of the earth's crust from the very beginning for it will lead to the study of the crust from the interior *upwards*.

The region of demarcation between the mantle and the crust is the Mohorovicic discontinuity, known as the Moho, which is more or less well established on account of its showing a well-defined break in physical properties of the materials on either side of it. The existence of this discontinuity is obtained from knowledge of the velocity of the compressional earthquake waves which show a sudden jump from about 21,000 ft./sec. on the one side to about 27,000 ft./sec. on the other. In the rocks above the Moho the seismic wave velocity increases downwards from 4 to 6·7 km./sec. which is explained as due to the variable composition of the rocks. On the other hand, below the Moho, that is on the uppermost part of the mantle, the velocity is surprisingly constant at 8·1 km./sec. showing that the sub-crustal rock is fairly uniform in composition. The Moho is about 20 miles (35 km.) below the surface under the continents, but may be as close as 2 to 3 miles (4-5 km.) under the deepest ocean floor. The layer below the Moho does not come to the surface and therefore it is necessary to drill to find out unambiguously the nature, chemical composition, radioactivity, etc., of the material that forms the earth's mantle—at least the fringe of it.

According to *Science Newsletter* plans to bore a hole 3 miles deep in the ocean floor have been made by a special committee of the National Academy of Sciences—NRC. The idea is to drill down through all the layers of sediment covering the ocean floor and obtain samples all the way down and from below the Mohorovicic discontinuity. The overall properties of material through which the drill hole would pass could be measured to great advantage. For example, data on temperature gradient and conductivity would lead to a better understanding of heat flow in the interior of the earth. The magnetic properties of the samples at different depths would throw more light on the magnetic anomalies at sea and also explain the remnant magnetism of the rock samples and problems connected with palæomagnetism.

Analysis of samples in the 1,500 ft. deep soft sedimentary column below the ocean bed would elucidate the depositional processes that have been going on in the past. A complete picture of the sedimentary column might also show the appearance of the first life in the sea and perhaps a clue to its origin. There might be unexpected discoveries also in this probing adventure into such new and unexplored territory as a hole miles deep in the ocean floor.

Difficulties of boring a hole to the earth's mantle under the ocean floor are indeed great. It is to the oil industry that we owe most of the recent developments that have taken place in drilling. The deepest hole so far drilled on *terra-firma* is over 4 miles. For underwater boreholes, the drilling will have to be done from floating vessels which again brings up new problems to be faced. Techniques already afoot for underwater rock sampling, off the California coast may help in the development of methods to meet the new requirements. In one of the Californian offshore trials a 300 ft. hole was drilled in a depth of 600 ft. of water. But drilling a 10,000 ft. hole under a depth of 20,000 ft. of water apparently raises problems

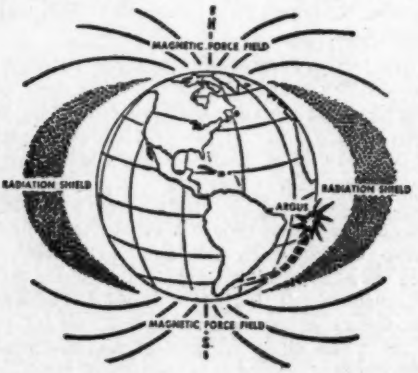
of enormous magnitude, but it is believed that they are not beyond present engineering skill.

The choice of a site for the ocean borehole is one of major importance. The Moho should be as near as possible which means the ocean depth will be great, the weather should be good, and the effects of disturbing factors like ocean currents, etc., negligible, for it is no use to take arms against a sea 'of troubles'. One suggestion is that the hole be dug in the Gulf of Mexico, north-west of Cuba, which has the additional advantage that the help of scientists from oil companies drilling for offshore oil would be available.

The progress of the ocean Borehole Plan of the Moho Committee of the American Miscellaneous Society (AMSOC) will be watched with great interest by scientists all over the world.

"PROJECT ARGUS" : CREATION OF ELECTRON BELT AROUND THE EARTH

WHAT is likely to be one of the major achievements of the International Geophysical Year was the artificial creation of a trapped belt of high energy electrons around the earth, ranging to an altitude of about 4,000 miles and following the lines of the earth's magnetic field. This was the planned result of the U.S. Atomic Energy Commission project called the "Project Argus", in which three nuclear rockets were exploded at altitudes of about 300 miles, on August 27 and 30 and September 6, 1958, from naval ships stationed in the South Atlantic at about 41° S. latitude, due east of Patagonia.



The diagram shows the location and the results of the explosions last summer by the U.S. Atomic Energy Commission over the South Atlantic, "Project Argus". A radiation shield was formed around the earth by the enormous quantity of electrons ejected, open only at the polar regions, where the magnetic lines of force dip towards the earth.

—By courtesy of the *New York Herald Tribune* and the '*Hindu*' March, 29, 1959.

For the first time in history, geophysical phenomena on a world-wide scale were being related to a quantitatively known cause, namely, the injection into the earth's magnetic field of a known quantity of electrons of known energies at a fixed position and time.

The man-made electron shell was not a simple blanket covering of the globe, but it followed the lines of the earth's magnetic field from pole to pole. According to Dr. Herbert York of the U.S. Defence Department, the electron belt was actually crescent-shaped in cross-section in the meridian plane. After each atomic burst it was only a matter of hours for the electrons to spread into the belt around the world. Each explosion was characterized by a brilliant initial flash of the burst, succeeded by a fainter but persistent auroral luminescence extending upwards and downwards along the magnetic line of force through the burst point. Almost simultaneously, at the point where this line of force returns to the earth's atmosphere in the northern hemisphere, near the Azores Islands, a bright auroral glow appeared in the sky which was observed from an aircraft previously stationed there in anticipation of the event. The satellite, Explorer IV, which was launched on July 26, 1958, moved through the trapped electron radiation hour after hour and day after day, in its orbital motion around the earth of periodic time about 110 minutes (see *Curr. Sci.*, 27 (12), 481). On its traverses through the electron shield, the counter tubes and telemetry instruments installed in the satellite recorded and reported to ground stations data about absolute intensity and position of this shell of electrons. The physical shape and position of the shell have been accurately plotted out and the decay of intensity has been observed. It is reported that the artificially induced radiation was about comparable to the radiation in the hottest parts of Van Allen Belt (Zone of cosmic or corpuscular rays trapped in earth's magnetic field).

The scientific findings are due to be published more fully at the annual meeting of the National Academy of Sciences on April 27-29.

CATCHING "BRAIN WAVES" ON TELEVISION SCREEN

ELECTRIC impulses exist in all the tissues and organs of the human body. Heartbeats are also attended by electric impulses. That has furnished the basis for the construction of the special instrument, electric cardiogram, which is of great value for diagnosing heart diseases.

The human brain, and the cerebral hemispheres especially, also discharge electrical impulses, which are, however, very faint, the electric impulses of the heart being hundreds of times more powerful. These impulses, like any other alternating electric current, create around themselves an alternating electromagnetic field, which in its turn creates electromagnetic waves. These "brain waves" are sent off into surrounding space and may be recorded by a sensitive receiver at a short distance.

Two Soviet engineers—Prof. M. Livanov and V. Ananyev, have designed an instrument for recording "brain waves" on television screen. Recently at the laboratory of the All Union Physics Research Institute of USSR Academy of Sciences Prof. Livanov demonstrated his instrument, the "Brain Televisor". The man whose brain waves were to be recorded on the TV screen was placed in a special chamber which was completely isolated from the possible action of electric interferences and outside noises. A special semi-spherical helmet with 50 contacts was placed upon the man's head. Each contact is a glass tube with fine metal conductors and cotton wicks inside. The cotton, steeped in a conducting liquid, was applied to the skin of the head. Communication with the man in the chamber was maintained only by telephone. Received by the contacts of the helmet the electric impulses of the brain were conducted by wires to powerful electronic amplifiers. The outlines of the cerebral hemispheres were on the screen of the TV tube, the convolutions were indicated by dotted lines.

The receiving set was switched on and flickering bright dots appeared on the outlines of the hemispheres. The dots signified electric currents received by the sensitive electrodes of the helmet from one or another region of the brain. Under the hemispheres on the TV screen, there was a shining diagram composed of fifty-five vertical lines, the length of which corresponded to the power of the charge of the electric impulses.

Five rows of dots, ten dots in each, were visible on the surface of the outline of the hemispheres on the TV screen. The dots disappeared and reappeared again, growing, their brightness changing, ... and the diagram of the power of the electric impulse changed accordingly.

Prof. Livanov asked the man in the chamber by telephone to solve a mathematical problem. One could see the shining dots on the screen change their brightness and distribution markedly, drawing together in groups. Then the dots gradually returned to their original position and paled away. The professor received the answer to the problem by telephone.

And so, while the man in the chamber was solving the problem, the electric impulses of the brain were more intensive than usual, which was reflected at once on the TV screen. When the problem had been solved, the electric impulses became fainter, and the TV screen showed that too.

The "Brain Televisor" is being used already with great success by doctors in diagnosing various cerebral disorders. It also affords the possibility of locating malignant tumours of the brain and finding their exact place. Should the cerebral cortex contain any affected places, the electric impulses there will be fainter, or will be absent completely, and this will be indicated immediately by the televisor.

—L. Yovich: *USSR News.*

ATOMIC LAMP

AN atomic lamp, which is expected to shine for at least ten years without attention or renewal of the power-source, has been made by a team of Harwell scientists led by Dr. Edward Wilson. The light is powered entirely by Krypton 85, a radioactive gas which is used to bombard the phosphor lining of the lamp and makes it glow. This gas will soon be available as a cheap by-product of atomic processes.

The atomic lamp is, however, not capable of replacing the type of bulb used for domestic and other lighting. It does not compare in intensity, at any rate for the moment. It should prove very useful wherever it is essential that the light-source should not go out accidentally. It could also be very valuable in mines and ammunition dumps, because it cannot cause an explosion.—*SACSIR Science News Selections.*

ACCELERATED RESAZURIN REDUCTION TEST FOR MILK

H. LAXMINARAYANA, SATISH VERMA, S. R. JAYASHANKAR AND K. K. IYA

National Dairy Research Institute, Karnal

AMONG the platform tests used for the rapid detection of poor quality milk supplies, received at the dairy plant or collection centre, the ten minutes resazurin test has been considered to be the most satisfactory method available for picking out samples having excessive numbers of bacteria and leucocyte cells.[1,2] The need for adopting a much quicker method of testing milk supplies on the receiving platform is, however, widely recognised. In the course of the studies on the development of a suitable bacteriological test for the above purpose, the possibility of shortening the time taken for reduction of resazurin or methylene blue in milk by stimulating or accelerating the dehydrogenase activities of bacteria has been explored.

A number of substances, *e.g.*, B. complex vitamins, amino acids, sugars, hydrolysates of casein, commercial peptones, yeast extract and beef extract, which are known to stimulate bacterial growth and metabolism, were added to milk and the effect on the reduction of resazurin and methylene blue was studied. Among the materials tried out, riboflavin was found to cause a slight acceleration in the reduction of the indicators when milk contained a preponderance of particular species of bacteria. Reducing agents such as ascorbic acid, cysteine and glutathione caused a marked reduction of the indicators but they were effective even in pasteurised and boiled milks in the absence of any bacterial activity. It was, however, interesting to find that the addition of certain commercial peptones, yeast extract and beef extract in small concentrations had a very marked effect on the reduction of O/R indicators, particularly resazurin, in milk containing large numbers of actively growing bacteria. The addition of these materials to raw milk, containing very few bacterial cells, also showed some accelerating effect on the reduction of resazurin presumably due to the activation of some milk enzymes, but this effect was not produced in pasteurised and boiled milks. Paper chromatographic analysis of the peptone or yeast extract revealed that one particular component, which moved to a position corresponding to R_f value of about 0·51 in the chromatogram (butanol-acetate-water) appeared to be the activating factor.

The results of representative trials showing the effect of addition of peptone in different concentrations to milk samples, containing different levels of bacterial population, on the reduction of methylene blue and resazurin are shown in Tables I and II. It may be seen that the reduction of both the indicators is markedly accelerated by the addition of peptone and that this effect is progressively intensified with increase in the concentration of peptone as well as in the numbers of bacteria.

TABLE I

Effect of adding Stearn's peptone on the reduction of methylene blue and resazurin in milk*

Milk sample	Standard plate count per ml.	Methylene blue reduction time		Resazurin reduction disc numbers (Lovibond)					
				Without peptone			With peptone		
		Without peptone	With peptone	At the end of 2 min.	At the end of 10 min.	At the end of 60 min.	At the end of 2 min.	At the end of 10 min.	At the end of 60 min.
	(Millions)	(Hr. Min.)	(Hr. Min.)	(Disc Numbers)					
1	0·017	5-10	5-0	6	6	5½	6	5½	5
2	0·254	4-50	4-40	6	5½	5½	6	5½	5
3	0·450	3-50	3-15	6	5½	4½	6	5½	4
4	3·250	2-10	1-15	5½	5	3½	5½	5	3
5	20·500	0-22	0-15	5½	4	3	3	1	0
6	45·000	0-13	0-2	5	2½	0	½	0	0
7	91·000	0-8	0-2	4	½	0	0	0	0
8	150·000	0-5	0-1	4	½	0	0	0	0

* *Peptonum Siccum Stearns* (Frederick Stearns & Co., Detroit, U.S.A.).
Concentration: 0·2% (0·2 ml. of 10% peptone solution in 10 ml. milk).

TABLE II

Effect of adding Stearns peptone in different concentrations on the reduction of resazurin in milk

Milk sample	Standard plate count per ml.	Incubation time	Concentration of peptone (per cent.) 0·0	0·05	0·10	0·20	0·25
	(Millions)	(Minutes)	(Resazurin disc numbers)				
1	0·019	2	6	6	6	5½	5½
		10	5½	5½	5½	5	5
2	0·225	2	6	6	5½	5	4½
		10	5½	5½	5	4½	3½
3	6·110	2	5½	5	4½	4	2
		10	4½	4	2½	2½	1
4	33·000	2	5½	3½	2	½	½
		10	4	1½	1	0	0

It was also found that the resazurin disc numbers of milk samples containing peptone at the end of *two* minutes were generally comparable with the readings given by the corresponding control samples on the *ten* minutes reduction test. Thus, by adding a suitable concentration of the peptone, it may be possible to shorten the incubation time for the resazurin reduction test to less than five minutes and obtain information regarding the quality of milk supplies on the basis of which they may be accepted or rejected on the receiving platform. Based on these observations, a *two* minutes accelerated resazurin reduction test for milk has been developed and the results of some trials carried out to grade milk samples by the new test as compared to the ten minutes resazurin test are shown in Table III.

TABLE III

Comparative grading of milk supplies by the Ten *minutes and* Two *minutes (Accelerated) Resazurin tests*

	Grading by *ten* minutes Resazurin test (Disc number)	Number of samples	Distribution of samples according to Resazurin disc numbers in the *two* minutes (accelerated) test (Disc numbers) 6, 5 & 4	3½ to 2	1½ to 1	½ & 0
1	6, 5 & 4 (Good)	21	14	5	1	1
2	3½ to 2 (Fair)	18	1	7	6	4
3	1½ to 1 (Poor)	6	..	..	..	6
4	½ & 0 (Very poor)	17	..	..	..	17

Further investigations are in progress to isolate the particular fraction of peptone responsible for accelerating the reduction of resazurin in milk and to study the practical application of the method for the rapid bacteriological examination of milk supplies on the receiving platform.

1. *Ministry of Agriculture and Fisheries, England*, (1942), *Form C.* 150 (*T.P.V.*), *H.M.S.O., London.*
2. Gurbhagwant Singh, Laxman Rao, M. R. and Laxminarayana, H., *Indian J. Dairy Sci.*, 1948, **1**, 11.

SOME IGY DATA ON ANTARCTICA

THE scientific exploration projects of the Antarctic and the south polar region under the IGY programme have led to an accumulation of data on such wide ranges of subjects as aurora and airglow, ionospheric physics, cosmic rays, geomagnetism, oceanography, glaciology, gravity measurement and special studies in botany, zoology and microbiology. These data from groups of observers from different stations, when analysed, co-ordinated and published are bound to add greatly to our knowledge of the ice-sheathed continent.

Seismic measurements of ice thickness indicate that there is probably 40% more ice in the Antarctic than previously thought. The U.S.-IGY team at Bryd Station measured ice 14,000 ft. thick, resting on bed rock 8,200 ft. below sea-level. This may be the thickest ice measured anywhere in the world. Deep drilling operations to more than 1,000 ft. depth have brought up cores of ice which fell as snow over 1,000 years ago. Analysis of the ice cores is expected to throw more light on past climates.

A record low temperature of −125·3° F. was reported by the USSR—IGY station near the centre of the continent. It was reported that during the Antarctic mid-summer the south pole receives more sunlight than any other place on earth. But as nearly 95% of the radiation is reflected by the ice cover the pole itself is left one of the coldest spots in the world.—*Bull, Am. Met. Soc.*, January 1959.

LETTERS TO THE EDITOR

REVERSE-PHASE CHROMATOGRAPHY OF FAT-SOLUBLE DYES

In previous communications from this Laboratory[1-2] methods have been described for carrying out the chromatography of fat-soluble dyes on filter-paper treated with liquid paraffin, silicone, etc. A number of eluants employed for the development of chromatograms have also been described there.

On extending the investigations to the analysis of mixtures of fat-soluble dyes it was noted that a very clear resolution of a dye mixture into its constituents is obtained if the chromatograms are run at 30° ± 1° C. on a liquid paraffin-impregnated paper, using mixture of acetone and water (70 ml. + 30 ml.) and acetone, pyridine and water (25 ml. + 10 ml. + 40 ml.) as the developing agent. The dye spots that separate out on the treated paper are compact and give fairly reproducible R_f values. A typical chromatogram is given in Fig. 1.

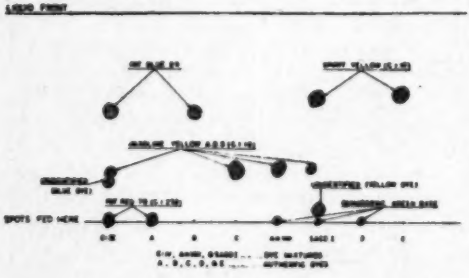


FIG. 1

The latter eluant has been described by Fujii[3] for untreated paper.

Full details will be published elsewhere.

National Physical Laboratory, Hillside Road, New Delhi-12, December 18, 1958.

M. R. VERMA.
RAMJI DASS.
JITENDRA RAI.

1. Verma, M. R. and Ramji Dass, *J.S.I.R.*, 1957, **16 B**, 131.
2. — and —, *Naturwiss.*, 1957, **44**, 351.
3. Fujii, S., *Bull. Nat. Hyg. Lab.*, 1955, **73**, 355.

STUDY IN ELECTRODE OF THE THIRD KIND: ACTIVITY COEFFICIENTS OF CALCIUM CHLORIDE IN DILUTE AQUEOUS SOLUTIONS

THE thermodynamic properties of a salt solution by means of electrode of the third kind has been studied by only a few investigators. Le Blanc and Harnapp[1] using electrode $Hg/Hg_2WO_4 - CaWO_4 - Ca$ and $Hg/Hg_2C_2O_4 - CaC_2O_4 - Ca$ reported that only the second cell is serviceable. According to these authors the electrode Cd/Cd stearate — Ca stearate — Ca is also unsuitable since it does not respond to the changes in Ca. Schmidt and Greenberg[2] have experienced difficulties in attaining equilibrium with a zinc oxalate electrode. It seems that in their studies with the electrode of the third kind the technique was inadequate. The cell should be designed to maintain strictly oxygen-free condition as oxygen renders the electrode unreliable.

The activity coefficient of calcium chloride in dilute aqueous solution has been determined by using the cell of the type: $Pb - Hg/PbC_2O_4/CaC_2O_4/CaCl_2$ $(m)/AgCl - Ag$. The electrode reaction is $Pb + CaC_2O_4 = PbC_2O_4 + Ca^{++} + 2e$, which behaves reversibly with respect to calcium ions. Electrodes of this type employing single concentration cell in dilute solutions are useful in determining the activity of the metallic ions, the metals of which cannot be used as electrode of the first or second kind owing to their reactions with aqueous solutions. The technique involved in the operation of this type of cell and the apparatus employed are similar to those of Joseph.[3] The improved apparatus is a H-shaped cell with two stop-cocks so that air could be expelled from the vessel. The tube containing the electrode lead amalgam in contact with solid lead oxalate and calcium oxalate was placed in the cell and made tight at the ground glass joint. Mercury was placed in the cup as illustrated in another paper[4] to make it air-tight. Silver-Silver chloride electrode was also tightly inserted on the other side of the cell. Collodion was not used for fixing the cellophane to the glass as described in earlier method[3] but tied by means of a thread.

The stock solution of calcium chloride was made up by dissolving a weighed amount of

extra pure calcium chloride in a weighed amount of conductivity water. The solution was stored in an atmosphere of hydrogen. Silver-Silver chloride electrode was prepared by the method of Spedding, Porter and Wright.[5] Lead amalgam was prepared in accordance with the direction of Cowperthwaite and La Mer.[6] Freshly precipitated pure lead oxalate and calcium oxalate were used in most of the experiments. The apparatus was placed in a water thermostat maintained at 25° C. and the E.M.F. measured with a potentiometer at intervals of ten minutes.

Generally, the equilibrium between the calcium chloride solution and the two solid phases was established within an hour. While experimenting with cell employed by Joseph without replacing air by hydrogen, the E.M.F. showed a tendency to fluctuate. This difficulty increased with the increase of concentration of calcium chloride and consistent reproducible E.M.F. was not obtained.

TABLE I

Molality (m)	e in volt: 1st Determi.	2nd Determi.	Mean	$-(e-e^*)$	$-\log \gamma/\gamma^*$	γ
0·0010	0·5672	0·5672	0·5672	0·0000	0·0000	0·888
0·0020	0·5424	0·522	0·5423	0·0249	0·02042	0·84721
0·0050	0·500	..	..	0·0572	0·05433	0·78538
0·010	0·4863	0·4865	0·4864	0·0808	0·08941	0·72277
0·020	0·4634	0·4634	0·4634	0·1038	0·13113	0·67657
0·050	0·4335	0·4339	0·4337	0·1335	0·19447	0·56747
0·060	0·4298*	..	..	..	..	..
0·080	0·3526*	..	..	..	..	..

* Satisfactory equilibrium not reached.

The electromotive force (e), activity coefficient (γ) and the concentration (m) are related according to the equation :

$$e - e^* = -\frac{3RT}{2F} \ln \frac{\gamma m}{\gamma^* m^*},$$

where e^*, m^* and γ^* are the E.M.F., molality and the activity coefficient respectively of the most dilute solution of the series (Standard E.M.F. of the cell). In calculating the values of the activity coefficient in Table I, it was assumed that γ is 0·888 at 25° C. for 0·001 m $CaCl_2$ solution based on the result of Scatchard and Tefft.[7]

Activity coefficients of the aqueous solutions of calcium chloride have been determined by E.M.F. method using mostly calcium amalgam electrode. Robinson[8] has suggested that in all these measurements the calcium amalgam electrode is not reversible and according to him the results of earlier investigators are, therefore, doubtful. The electrode employed in the present investigation is free from such objections. The results obtained in Table I on the activity coefficients of calcium chloride in dilute aqueous solutions by the use of electrode of the third kind are in good agreement with those found by other methods.

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BLOOD TRANSAMINASE STUDIES IN PROTEIN REGENERATION

It was observed by Phansalkar, Ramachandran and Patwardhan (1958) that in adult rats the total circulating hæmoglobin and plasma proteins were reduced by 56% and 48% respectively when these animals were fed protein free diet for eight weeks. When protein repletion was commenced at this period with two vegetable protein mixtures (*a*) wheat, red gram and amaranth, (*b*) bajra, red gram and amaranth using skim-milk as control, the blood proteins tended to return to normal on all the three diets within three weeks. However, the rate of regeneration of hæmoglobin and plasma protein was slower on vegetable protein diets than on skim-milk.

Tulpule and Kshirsagar (1958) have observed that glutamate-oxaloacetate transaminase (GOT) activity in whole blood was decreased when the rats were maintained on low protein but otherwise complete diet and the enzyme activity returned to normal when adequate protein was restored in the diet. It was considered worthwhile, therefore, to study the GOT activity of blood during protein regeneration and to compare the results with the changes in blood proteins.

Forty male albino rats, four months old, with an average weight of 225 g., were fed protein-free diet for eight weeks. The rats were then divided into three groups and fed the diets containing the following foods as sources of protein :

Diet 1. Skim-milk (10% protein).
Diet 2. Wheat (6% protein) + red gram (3% protein) + amaranath (1% protein).
Diet 3. Bajra (6% protein) + red gram (3% protein) + amaranth (1% protein).

During the protein repletion period, the same amount of diet was fed to all the rats in each of the three groups every day to ensure identical intake of protein and calories in different groups. At the end of the protein depletion period and at different intervals during blood protein regeneration in the animals on the three types of diets mentioned earlier, blood samples were drawn by cardiac puncture and GOT activity of blood was determined by the method of Tonhazy, White and Umbreit (1950) using hæmolysed whole blood as the source of enzyme. The blood samples were also analysed for hæmoglobin, plasma proteins and total blood volume as has already been described by Phansalkar *et al.* (*loc. cit*).

activity was associated with the increase observed in total circulating hæmoglobin and plasma proteins over the depletion levels. There was a further increase in the enzyme activity in all the groups on the seventh day and in the subsequent period up to 21 days the changes in the enzyme activity were comparatively small. Although the rate of regeneration of blood proteins in animals on vegetable protein diets was lower than that on skim-milk diet (Phansalkar *et al., loc. cit.*), no difference was noticed in blood GOT activities on the vegetable and milk diets.

These observations strengthen the view that the apoenzyme of GOT is susceptible to the level of dietary protein intake.

Nutrition Research Labs., Indian Council of Medical Research, Coonoor, S. India,
October 11, 1958.

P. G. TULPULE.
S. V. PHANSALKAR.
M. RAMACHANDRAN.

TABLE I

Effect of protein repletion on blood GOT activity in protein depleted rats

Diet	After eight weeks of protein depletion		Days after restoration of protein in diet									
			3				7					
			Total circulating				Total circulating				Total circulating	
	No. obs.	GOT units	Hb. (g.)	Plasma proteins (g.)	No. obs.	GOT units	Hb. (g.)	Plasma proteins (g.)	No. obs.	GOT units	Hb. (g.)	Plasma proteins (g.)
Skim-milk ..	12	114	1·453	0·263	4	165	2·358	0·470	4	246	2·862	0·518
Wheat + red gram + amaranth	14	101	1·427	0·255	4	162	2·131	0·473	5	199	2·665	0·502
Bajra + red gram + amaranth	14	100	1·393	0·227	4	153	1·965	0·438	5	239	2·403	0·461

Diet	Days after restoration of protein in diet							
	14				21			
			Total circulating				Total circulating	
	No. obs.	GOT units	Hb. (g.)	Plasma proteins (g.)	No. obs.	GOT units	Hb. (g.)	Plasma proteins (g.)
Skim-milk ..	4	211	2·843	0·542	4	224	2·995	0·596
Wheat + red gram + amaranth	5	212	2·972	0·558	7	213	3·056	0·515
Bajra + red gram + amaranth	5	235	2·523	0·513	8	247	2·837	0·537

GOT unit : μg. pyruvic acid formed by 1 c.c. of blood in 10 minutes reaction at 37° C.
Blood GOT activity of stock control rats (average of six observations) — 176 units.

It will be seen from Table I that at the end of eight weeks period of protein depletion, blood GOT activity was considerably reduced as compared to the stock controls. Activity of GOT in blood increased by about 50 to 60% within 3 days of the start of protein repletion in all the three groups. This increase in enzyme

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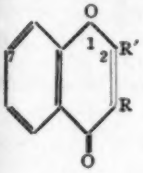
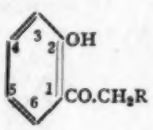
ON THE USE OF METHOXALYL CHLORIDE IN ISOFLAVONE SYNTHESIS

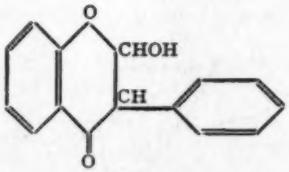
VARIOUS sources of the C_2-atom in the synthesis of isoflavones (I, R = phenyl, R′ = H) from benzyl-*o*-hydroxy phenyl ketones (2-hydroxy deoxybenzoins) (II) are known; but the synthesis of hydroxy isoflavones, without the protection of hydroxyl groups in hydroxy-deoxybenzoins has only been achieved recently. Baker *et al.*[1] used ethoxalyl chloride as the source of the C_2-atom while Farkas[2] obtained it by the action of hydrochloric acid gas on zinc cyanide, the former being most widely employed. The use of methoxalyl chloride for isoflavone synthesis has not so far been reported. The present work deals with the use of methoxalyl chloride in order to see (i) if it would be more efficient than ethoxalyl chloride and (ii) if it would give almost invariably 2-hydroxy isoflavanones[3] (III) in place of isoflavones (I, R = phenyl, R′ = H) as is the case when methyl formate is used instead of ethyl formate in isoflavone synthesis.



I



II



III

In the course of our work it has been found that methoxalyl chloride is more efficient as far as the yields of the intermediate esters and their ease of hydrolysis are concerned. There is no formation of 2-hydroxy-isoflavanones.

The use of this source of the C_2-atom has yielded 7-hydroxy (I, R = phenyl, R′ = H, OH at 7) and 5, 7-dihydroxy isoflavones (I, R = phenyl, R′ = H, OH at 5 and 7) in yields of about 70%, identical with the products prepared by the ethoxalyl chloride method.[4]

The intermediate esters, 2-carbmethoxy-7-hydroxy isoflavone (I, R = phenyl, R′ = COOMe, OH at 7), m.p. 220-22° and 2-carbmethoxy-5, 7-dihydroxy isoflavone (I, R = phenyl, R′ = COOMe, OH at 5 and 7), m.p. 220-21° not reported earlier, have also been obtained. They have been identified by hydrolysis to the corresponding acids which were confirmed by mixed melt with authentic samples of the acids obtained by ethoxalyl chloride method.[4]

Further work is in hand.

Dept. of Chemistry, Muslim University, Aligarh, India, *November* 5, 1958.

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M. A. SIDDIQUI.

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CHROMATOGRAPHIC DETECTION OF THE ORGANIC CONSTITUENTS OF *GORIKAPULI* (*GARCINIA CAMBOGIA* DESR.) USED IN PICKLING FISH

EFFICIENT preservation of fish over long periods is achieved by "Colombo" method, *viz.*, pickling in brine containing *Gorikapuli* or *Kodapuli* or Malabar Tamarind (dried fleshy pod of *G. cambogia*).[7] In this note an attempt is made to correlate the effect with the constituents of the preservative.

Ceylon pod (15-20 g.) imported by Malpe merchants was acidified with acetic acid (omitted for detection of amino acids),[6] ground with 70% ethanol and filtered through fine cloth. The centrifuged filtrate was made up to a definite volume and aliquots were used for detecting organic acids[4] and sugars.[2,3] Both aqueous and ethanolic extracts were used for detection of polyphenols,[1] which were developed on paper chromatograms with the solvent system butanol-acetic acid-water (4 : 1 : 5) and sprayed with ferric chloride or ammoniacal silver nitrate.

No free amino acids were found in ethanolic or aqueous extracts. A band corresponding to fructose-arabinose-xylose was noticed. While aqueous extracts apparently lacked polyphenols, a fast moving polyphenol in ethanolic extract unidentifiable by R_f value with any known tannin, was located very near the solvent front. No volatile acid could be detected but citric

and tartaric acids[8] (*cf.* occurrence of malic and tartaric acids in tamarind from *Tamarindus indica*)[5] were present, which apparently lowered the pH of the pickling medium to 5·4, and thereby featured as bacteriostats. Absence of *Staphylococcus* in the cured product may be attributed to this, as was affirmed by Ingram, in a discussion.[7] The role of a reducing sugar and of the polyphenol in preservation of fish by this process is worth studying.

This note is published with permission of the Director of Fisheries, Madras.

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May 24, 1958.

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SYNTHESIS OF TARTARIC ACID IN TAMARIND LEAVES

THE fruit of the Tamarind tree (*Tamarindus indica*, Linn.) is the most acid of all natural foods, the content of the chief acid present, tartaric, being as high as 14-18%.[1,2] The seat of synthesis of the acid is in the leaves, which maintain a high concentration of tartaric acid during the first few months of the season. The acid synthesised is apparently continuously translocated to the berries, which are very sour from the beginning to the ripening stage, containing about 11% free and 5% combined acid. The only acids in the leaves are tartaric and malic,[3] and we have found that the berries also contain only these two acids, identified chromatographically. There is no known pathway of metabolic utilisation of tartaric acid in plants.[4] Although in some plants like the grape, a certain degree of metabolic utilisation of tartaric acid is assumed during ripening nevertheless, it remains a difficult substrate for oxidation. Unlike in the case of other fruits, ripening in the case of tamarind fruit is not accompanied by any decrease in the acid content (about 16-18% in both). The accumulation of invert sugars to the extent of 30-40% during the ripening stage gives the harvested fruit a sweeter taste.

It was of interest to study the composition of the leaves at different stages of fruit growth, starting from the time the fresh bright green foliage comes up (April-May) followed by the appearance of flowers and then small berries, and ending with the time the fruit is ready for harvest (January-February) and when the leaves are a dark dull green. The results are graphically given in Fig. 1. Standard methods of A.O.A.C. were used for analysis.[5]

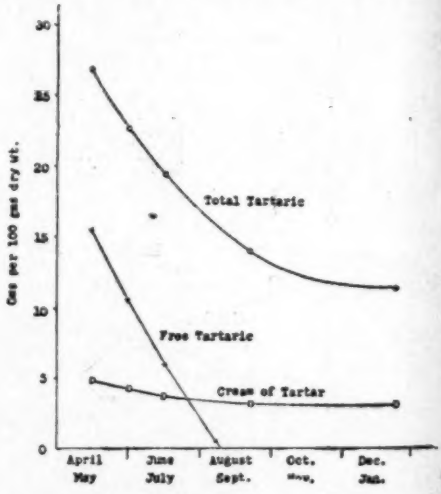

FIG. 1

Total tartaric acid and free tartaric acid are maximum in the fresh foliage. The vigorous metabolic processes going on at this stage are responsible for this. Blocking of enzyme systems necessary for further oxidations is supposed to be responsible for such accumulation of acids. Tartaric acid is an uncommon plant acid. Although other mechanisms for the synthesis of tartaric acid are doubtless equally likely, there is a possibility that the accumulation of this substance in certain plants is the result of a metabolic conversion of D-glucose

whereby carbon atoms 5 and 6 are removed, leaving a 4-carbon unit which is oxidised to the dicarboxylic acid. Being of a configuration that cannot be further attacked by the enzyme systems present (+)—tartaric acid accordingly accumulates. This oxidative mechanism of glucose is uncommon.[6] Whatever be the mechanism of acid production-carbohydrate breakdown, CO_2 fixation or amino-acid degradation, the tartaric acid formed does not enter back into the metabolic cycle. In starvation experiments conducted with excised leaves according to the technique used by Puchel *et al.*[7] we could not detect any decrease in tartaric acid content even under extreme starvation. Neither oxalic nor tartaric acids fit into known organic acid metabolic systems. The accumulation of acid to a high concentration in the leaves during the first few months of the season implies that the rate of production of the acid exceeds the rate of withdrawal. Since metabolic utilisation is very sluggish, if at all, the only outlet for the acid produced is translocation to the berries. As the berries grow bigger, they can take up most of the excess acid from the leaves in addition to synthesising some of their own, and the free acid content of the leaves ultimately drops to zero. Meanwhile, more calcium is also absorbed to neutralise the excess acid in the leaves (Fig. 2).

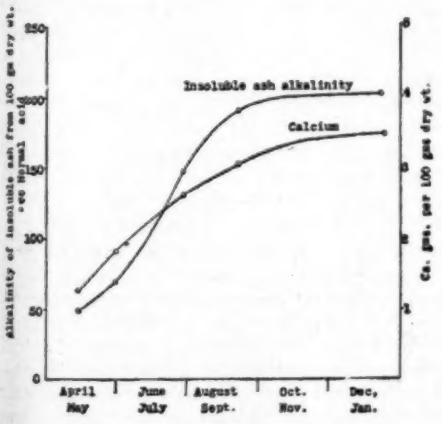

FIG. 2

Grateful thanks are due to Dr. D. S. Bhatia and Director Dr. V. Subrahmanyan for their interest in the work.

Central Food Technological Research Institute, Mysore, November 8, 1958.

Y. S. LEWIS.
S. NEELAKANTAN.

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EXPERIMENTS ON PICKLING FISH WITH VINEGAR AND MALABAR TAMARIND*

IT has been suggested by Venkataraman and Sreenivasan[1] that "Malabar Tamarind" (from *Garcina cambogia*) helps in the fermentation of fish in the "Colombo Curing" method owing to citric acid, tartaric acid and some polyphenols lowering the pH of the pickling medium and thereby inhibiting the growths of spoilage organisms. The use of vinegar for this purpose has now been explored.

Fresh oil sardines gutted and well washed, were packed in two sets of porcelain jars with one-third the weight of salt (I.S.I).[2] To one set, 5% by weight of tamarind and to the other 5% by weight of vinegar containing 5% of acid (expressed as acetic acid) were added. Within two days, self-brain covered the fish to the top The rate of spoilage in the two sets has been adjudged by taking samples periodically and estimating pH, total volatile bases (TVB),[3] Trimethylamine (TMA),[3] total count (TC), halotolerant count (HTC) and red halophilic count[5,4] (*vide* Table I). Anærobes (plated on thioglycollate agar using spray dish technique) and acid tolerant organisms (Thermoacidurans agar)[6] were enumerated after six months to ascertain the extent of residual microflora. In the first set, this rate seems higher (from TVB and TMA values) and HTC, but not TC, goes up after two months although final TMA value in both sets are the same and well below spoilage level. The pH rises from 6·0 to a steady value 6·4 in a month while that of vinegar-brine changes from 5·2 to 6·0 falling to a steady value 5·4 after another month, the titratable acidity being 1·6 times higher than in the first set. The ærobic flora consisted of sporeformers, besides a few slender rods and a coccus. The anærobes were long filamentous, non-spore

* A paper read at the 45th Session of Indian Science Congress, Madras, 1958 and published with the kind permission of Director of Fisheries, Trivandrum.

Analytical data of the fresh and pickled fish showing changes in Bacterial count (10^3/gm.) TVB, TMA and pH values

Date	Total viable counts of fresh fish			Tamarind pickled sardines							Vinegar pickled sardines						
				Fish		Brine		Fish	Brine		Fish		Brine		Fish	Brine	
	Whole fish	Gutted fish	Gutts and Gills	TC	HTC	TC	HTC	TVB	TMA	pH	TC	HTC	TC	HTC	TVB	TMA	pH
	4·8	0·8	3·73														
2 days ..	..	..	..	1650	308	..	..	..	..	6	1840	294	..	..	..	..	5·2
32 days ..	..	..	..	156	..	56	28	14	0·35	6·4	250	..	419	340	14	0·35	6·0
63 days ..	..	..	..	84	14·1	89	8·1	105	0·7	6·4	4·7	8·4	162	6·8	85	0·35	5·4
6 months	..	..	..	680	1080	10	34	70	0·7	6·4	6·20	20	29	3·07	54·3	0·7	5·4

For salt used

TC	HTC	RHC
84000	400	Nil 20†

† The medium used for the red halophiles is supposed to be selective. Still white colonies of rods were seen on the salt-milk-agar.

forming rods and a short spore-forming rod. These did not digest or blacken liver infusion broths but formed gas even at pH 6·0. It is likely that they aid in keeping down the growth of spoilage organisms as suggested by Venkataraman and Sreenivasan.

The vinegar treated sardines were silvery white, their flesh being flaky, soft and of fruity flavour unlike the tamarind treated ones which were brown and hard covered in rancid brine. When fried they were like fresh fish save for the slight taste of the added agents. Vinegar treated sardines are better as judged from taste, appearance and also TVB and TMA values and thus the use of vinegar for pickling can be recommended.

A. G. Vasavan.
K. G. Varma.

Fisheries Technological Station,
Kozhikode-1,
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'ANORTHOSITE', A NEW FIND FROM AURANGA-KOEL-VALLEY, PALAMAU, BIHAR

A SMALL patch of anorthosite occurs near the magnetite deposits at Biwabathan village (23° 55′ N. : 84° 3′ E). The anorthosite is a white coarse-grained rock resembling white marble in appearance and is very compact and massive. The fresh surface of the rock gives shining lustre on account of the reflection of light from cleavage faces of the felspars, which show at times very fine twin striations also. Felspars up to 1 to 1¼" in length have been observed. The average specific gravity of the rock is 2·7.

Under the microscope the rock shows well developed plates and smaller euhedral to subhedral grains of felspars which constitute the bulk of the rock. Albite twinning is well developed and is universal (*see* Fig. 1). The symmetrical extinction angle varies between 35° and 40°. The optical axial angle of a clear piece was determined directly by the five axes stage and was found to be 78° with a positive sign. Thus the extinction angle and 2V indicate a composition of the plagioclases as having 53% An. Besides plagioclase, the rock contains hornblende, hypersthene, epidote-zoisite, scapolite, sphence and secondary quartz. On analysis the following result (percentage) was obtained :—

FIG. 1. Microphotograph of the rock section B.7 showing well developed albite twinning in felspars and accessories.

SiO_2	..	54·27
Al_2O_3	..	26·70
Remaining (FeO, Fe_2O_3, TiO_2, P_2O_5, etc.)	..	1·51
CaO	..	12·90
MgO	..	Traces
Na_2O	..	4·50
K_2O	..	0·20
Loss on ignition	..	0·83
TOTAL	..	100·91

The most striking feature of this anorthosite is its association with gabbroic rocks on the one hand and tremolite-schists, marbles, calc-silicate and granulites on the other. Sen and Roy Chowdhury[1] have reported the occurrence of anorthosite from Manbhum District of Bihar associated with calc-granulites, which they think, was formed by the high grade metamorphism of calcareous sediments with sufficient aluminous impurities. It is expected that a detailed study of the Palamau anorthosite will indicate whether it is magmatic or metasomatic metamorphic in origin.

Thanks are due to Dr. S. C. Chatterjee, Tata-Professor of Geology, Patna University, under whose supervision the work is under progress, and to Dr. G. C. Bhattacharya of the Chemistry Department of Ranchi College for his help in the chemical analysis of the rock.

Department of Geology, Ranchi College, Ranchi,
February 2, 1958.

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RENAL CLEARANCE OF UREA

IT has been stated that Indians have a lower urea clearance than Europeans and Americans.[2,10] A similar study carried out on the services personnel[11,12] failed to confirm these observations and showed that if blood urea was raised, whether by high protein diet or by ingestion of urea, the urea clearance increased. Object of this paper is to show that the renal clearance of urea is not related to race or any specific biological action of proteins, but is a function of the nitrogen load put on the kidney during the test.

To measure the true clearance of urea, which could be done only at a constant blood urea level, 5 healthy persons were given 15, 20, 25 and 35 g. of urea in 4 different experiments, and the bloods were collected at 30, 60, 90, 120 and 150 minutes after urea ingestion. Urea clearance was calculated from the highest blood urea and the output of urine in the last 60 minutes. The findings are presented in Fig. 1 and Table I. It is seen that :—

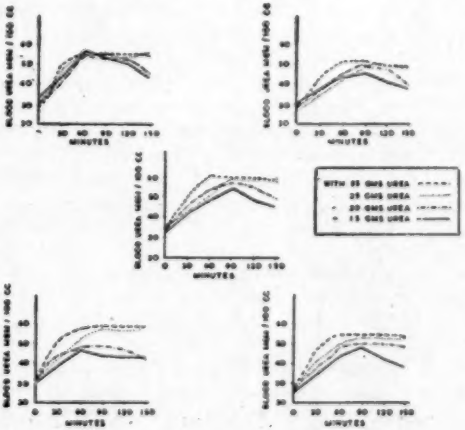

FIG. 1. Blood urea curves in 5 persons after ingestion of varying quantities of urea.

1. With 25 and 35 g. of urea, a constant range of blood urea is obtained at 90 minutes and this lasts for more than one hour.

TABLE I

Urea clearance test on 5 persons with 15, 20, 25 and 35 g. of urea orally

Serial No. (1)	15 g. (2)	20 g. (3)	25 g. (4)	35 g. of urea (5)
1 ..	70	75	94	96
2 ..	65	83	90	89
3 ..	77	90	99	101
4 ..	59	66	79	80
5 ..	52	70	85	82

All clearances were maximal clearances. Figures in columns 2, 3, 4 and 5 represent number of ml. of blood cleared of their urea.

2. The level of constant blood urea varies with individuals, but it remains lower than 60 mg.%.

3. Urea clearance acquires its peak with nitrogen load of 25 g. of urea.

Accordingly, 50 medical category 'A' subjects were tested for their urea clearance by the following procedure: The test was started 1½ hours after breakfast. The subject was given 25 g. of urea dissolved in 200-300 ml. of water and then allowed to rest. After 90 minutes the subject emptied his bladder and the urine was discarded. A sample of blood was collected for the base line of urea. The subject rested for further 60 minutes. Another specimen of blood was obtained for urea level at termination, and the entire quantity of urine that was formed and voided during the last 60 minutes preserved. The quantity of this urine was measured to the last ml. Urea in the two specimens of blood and the last urine was determined by the usual method. If the two blood ureas differed from each other by more than 5 mg.%, the test was repeated. The observations are presented in Table II, from which it can be inferred that the values so obtained are higher than the average clearance obtained in Europeans and Americans, and our own findings.[11] It was seen in these experiments that the rise in the urea clearance was due to increased concentration of urea in urine, and not due to diuresis.

TABLE II

Urea clearance test on 50 healthy services personnel with 25 g. of urea

	No. of persons tested	Age	Surface area sq. M.	Blood urea mg.%	Urea clearance
Maximal clearance ..	32	34·1	1·71	51·7*	93·1
SD ..	..	7·0	0·09	6·2	18·1
Standard clearance ..	18	36·8	1·69	51·4	67·8
SD ..	..	6·8	0·11	4·3	8·0

* There were only two persons who had a blood urea level higher than 60 mg.%. Repeated urine examination and a thorough clinical check up in both of them failed to reveal any abnormality.

Repeat tests were done on 10 of the above subjects with (*a*) 600 ml. of plain water, and (*b*) 15 g. of urea dissolved in 200 ml. of water followed by a further drink of 400 ml. of water. Comparison of these two and the findings with 25 g. of urea is presented in Table III, which shows that the clearance of blood urea rose with the increase in nitrogen load in all of them.

Rise in the renal clearance of urea with increase of dietary protein intake, recorded in literature,[3,4,6,8] has been explained by (*a*) the resultant hypertrophy of the kidney,[7,9,13] and (*b*) elevation of the level of blood urea.[1] Rise in urea clearance following increased intake of proteins has been found to be transitory[3,6] and there was regression with reversion to low protein diet; in animals there was even regression in kidney weight.[9] A similar effect on the urea clearance was observed in nephrotic children when they were fed creatinine.[4] Urea has also been found to be effective in this respect but to a lesser degree.[7]

Data presented in this paper confirm the observation that the increase in urea clearance resulted from the rise of blood urea. In view of the above and particularly if the ingestion of a single large dose of urea could produce so profound changes as seen in Table III, there does not seem to be any justification in attaching special importance to the role of proteins in raising the urea clearance.

The observations recorded here and earlier[12] confirm the findings of Goldring and Chassis,[5] though indirectly, in that the blood urea did not rise beyond 60 mg.% and there was increased excretion of urea in urine, in spite of the heavy nitrogen load.

The term maximal clearance apparently indicates the maximal capacity of the kidney to clear urea. Data given in Table III show that values generally obtained in clinical laboratories, whether with or without urea and when the rate of output of urine was more than 1·5 (2) ml. per minute, do not represent the maximal urea clearing capacity of the kidney. In view of variations in renal clearance of urea with changes in the nitrogen load, it is suggested that three terms should be used, *viz.*, "standard clearance",

TABLE III

Urea clearance in 10 persons with plain water, 15 g. of urea dissolved in 600 ml. of water and 25 g. of urea in 200-300 ml. of water

Sl. No.	Clearance in ml. with plain water	Clearance in ml. with 15 g urea	% increase in clearance by addition of 15 g. urea	Clearance in ml. with 25 g. urea	% increase in clearance over plain water	% increase in clearance over 15 g. urea
1	56	71	26·8	98	75	38·0
2	60	81	35·0	104	73·0	28·4
3	63	77	22·2	92	46 0	19·4
4	50	63	26·0	85	70·0	35·4
5	54	69	27·7	88	63·0	27·5
6	63	86	36·5	110	74·6	28·0
7	49	62	28·5	79	62·1	25·4
8	42*	58*	38·1	84	..	..
9	51	56*	..	93	76·4	..
10	59	70	18·6	99	64·0	38·5

All the clearance values have been given as the nearest whole number.

* Standard clearance.

"optimal clearance" and "maximal clearance". It is further suggested that the term commonly employed in clinical laboratories to indicate the output of urine of more than 1·5 (2) ml./minute be changed to optimal clearance. These changes fit in with the concept of actively functioning and reserve (sleeping) nephrons. With no load of nitrogen in the test with plain water, clearance seems to be effected by the small number of working nephrons. As the nitrogen load increases, increasing number of reserve nephrons are put into commission, till they reach the maximal capacity whence the urea clearance becomes constant.

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Armed Forces Medical College, Poona
November 7, 1958.

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MAGNETIZATION OF A METADOLERITE DYKE IN RELATION TO ITS PETROGRAPHY

A MAGNETIC study of portions of metadolerite dyke exposed in Dhaiya village, Dhanbad, and its extension into the Indian School of Mines premises was undertaken. The field work includes a magnetic survey of the dyke with a vertical force variometer and collection of oriented samples of the rocks from various portions of the dyke. The laboratory investigation includes a study of the petrography and magnetic properties such as permanent and susceptibility polarizations and direction of magnetization of the dyke.

The country rock here is quartz-felspathic gneiss. A metadolerite dyke runs in a N.N.W.–S.S.E. direction. The portion of the dyke in the School campus is a typical metadolerite while in Dhaiya area along with metadolerite there occurs epidiorite, which shows at places typical Rapakivi structure. The epidiorite and metadolerite seem to be genetically connected; the former may be a product of metamorphism and felspathisation of the latter.

The basic dyke rocks in the area under investigation may be grouped as:

(i) Non-felspathised, i.e., metadolerite, (ii) felspathised, i.e., epidiorite. The non-felspathised rock is greyish black in colour showing good laths of grey coloured felspar in hand specimens. Under the microscope it shows typical ophitic texture. Both orthorhombic and monoclinic pyroxenes are found. They show alteration to green uralite especially along the periphery. Some grains of pyroxene are fresh. The felspar is labradorite and shows typical cloudiness. Biotite shows strong pleochroism. Large grains of magnetite are found enclosed in pyroxenes and biotite. A little quartz is present in some sections. The felspathised rocks are rather light coloured and coarse grained and are either slightly gneissose or granulitic in structure. The sections show much alteration of pyroxenes to hornblende and even to biotite. Large crystals of felspar are

seen enclosing small grains of the ferromagnesian minerals. Garnet is usually present Quartz shows undulose extinction. Ophitic texture is completely lost and the rock has acquired granulitic texture. Magnetite is found as large irregular grains enclosed in pyroxene and biotite. The Rapakivi-like structure in this area described by Sharma and Agrawal[1] is considered as a special case of felspathisation of the basic rock.

Observations for vertical intensity of the earth's field were taken over the dyke using Askania vertical force variometer. Six traverses were laid across the dyke, three in Dhaiya area and three in the School of Mines campus. Pronounced magnetic anomalies were observed over the portions of the dyke in the School campus (non-felspathised portion of the dyke). But very low magnetic anomalies were observed in Dhaiya area (felspathised portion of the dyke). While the non-felspathised portion of the dyke is strongly magnetic, felspathised portion is very feebly magnetic. Oriented specimens of the two types of rocks confirmed the field observations. Laboratory study of the oriented specimens shows that 80-90% of magnetization of the non-felspathised rocks is due to remanence and the remaining due to induction. The magnetization of felspathised rocks is nearly one-fifth that of non-felspathised rocks. Magnetization of the dyke in the School campus is in the normal direction and has shallow dips. The declination varies from 37° West to 58° East of North. The magnetization of the dyke in Dhaiya is chiefly due to induction.

The remarkable change of magnetization of the portion of the dyke in Dhaiya appears to be connected with the felspathisation of the rocks. A detailed study of the magnetic properties of these rocks and their petrography is in progress and the results will be published elsewhere in due course.

Thanks are due to Prof. N. L. Sharma for his keen interest in these studies.

Indian School of Mines & Applied Geology, Dhanbad,
November 13, 1958.

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A NOTE ON THE EGGS AND LARVA OF *DINEUTES INDICUS* AUB. (COLEOPTERA—GYRINIDAE)

THE metamorphosis of aquatic Coleoptera has been a subject of considerable investigation in recent years.[2–4] It is of special interest in view of the recent report[2] on the embryonic cuticle shed by the larvæ of some Dytiscidæ. Information in development of Gyrinidæ is very fragmentary and limited to very old accounts.[3] The family Gyrinidæ presents one of the most remarkable larval forms with their special adaptation to aquatic life. The most striking feature of these larvæ is that they are apneustic. The following is a preliminary note and constitutes the first description of the structure of the egg and the larva of *Dineutes indicus* Aub.

Copulations were observed from 10th July until 5th of October both in the laboratory and in the field. The period of copulation on average appears to be 35 minutes and the least time taken by a pair is 10 minutes. The eggs are laid singly and in rows. The minimum number of eggs laid by a single female is 30 while the maximum number so far counted is 90 only. Each egg is affixed to a substratum by gelatinous substance which hardens within a few hours. Just after the oviposition the eggs are cylindrical but as the embryo develops they become broadly oval or subspherical. The average size of the egg is 1·8 mm. in length and ·7 mm. in breadth. The chorion has a characteristic hexagonal sculpturation. The vitalline membrane can be observed due to the fragile and translucent nature of the chorion.

Hatching takes place within 12 to 15 days at temperature 29° C. The chorion always splits lengthwise over the mid-dorsal line when the hatching is imminent. The empty egg shells show a single split starting from the cephalic pole almost to the posterior pole. Hatching has been observed under binocular microscope but the presence of provisional cuticle has not been noticed so far.

The freshly hatched larva is pale, transparent and measures on average about 4·5 ± ·5 mm. in length. Compared to the larvæ of Gyrinus these are very small in size. The larva is elongated and conspicuously segmented. The head is larger than the prothorax. Eyes are situated laterally. The antennæ are four-segmented, the apical segment being the longest. The mandibles are large, pointed and perforated by a sucking canal. The labial and maxillary palps are four-jointed. Each leg is

provided with paired claws and a conspicuous spine.

Each of the first eight abdominal segments carries a pair of plumose tracheal gills and the ninth has two pairs of similar organs. The tenth abdominal segment which appears to be inconspicuously divided bears posteriorly two pairs of long, cuspidate and cheliform spines. Their exact function has not been as yet ascertained. In addition to the above structures the tenth segment has two pairs of curved pygopods (*see* Fig. 1).

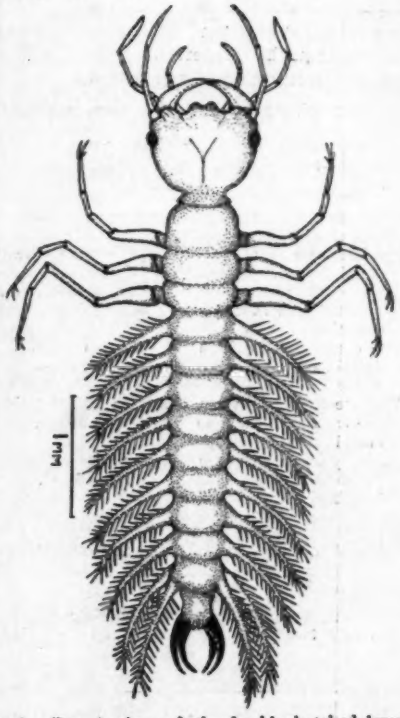

FIG. 1. Dorsal view of the freshly hatched larva of *Dineutes indicus* Aub.

The above brief account shows that the larva of *Dineutes* differs appreciably from that of *Gyrinus*, the limited descriptions of which are available.

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UTILISATION OF MAHUA CAKE AS MANURE

Of the methods which have been tried to utilise mahua cake as manure, none has met with complete success in making its nitrogen nitrify easily in the soil.[5,8] The presence of saponins has often been quoted as the cause of defective nitrification of the cake in the soil.[3,4,7] The cake is available annually in large quantities (about 30,000 tons) and practically no use is made except for fuel purposes. It was, therefore, thought desirable to investigate if extraction of the cake with suitable solvents could increase its nitrification in the soil.

The results (Table I) show that the cake can be nitrified to an extent of 18% during a period of three months by fractionally extracting it with alcohol and that such extracted cake gives an yield of cheena (*Panicum miliaceum*) several times that of the control. Extraction of the cake is possible in the modern solvent extraction plants which are coming in vogue in the country. The cost of alcohol used can be met with the extra amount of oil recovered (10%).

TABLE I

Nitrification of mahua cake and yield of cheena in Delhi soil

Treatment	Rate of nitrification (mg. per day*)	% nitrogen nitrified in three months	Average yield of cheena per pot (g.)
Control		..	0·24
Mahua cake (unextracted)		2·50	0·20
Mahua cake extracted with water		..	0·26
Mahua cake extracted with ether ..	0·049	10·00	0·58
Mahua cake extracted with alcohol	0·062	18·00	0·78
Mahua cake extracted with benzene	0·047	10·00	0·85
Mahua cake extracted with ether, benzene and alcohol ..	0·098	24·00	1·08

* Calculated from correlation between nitrate found in the soil and period in days.

Detailed results of the investigation are being published elsewhere.

Indian Agricultural Research Institute, New Delhi, *July 8, 1958.*

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OCCURRENCE OF *ANCHOVIELLA BAGANENSIS* HARDENBERG OFF EAST COAST OF INDIA

IN our studies on *Anchoviella* spp.[1] from various areas along the East Coast of India, we have come across a new species (for Indian waters), *Anchoviella baganensis* Hardenberg, from the Andhra Coast. Hardenberg[2] who first reported the species from Indonesian waters, divided it into two subspecies, *A. baganensis baganensis and A. baganensis macrops*, based on the diameter of the pupil, colour of the caudal fin, length of anal fin, number of gill rakers, and the number of vertebræ. This subdivision was substantiated by Delsman[3] from the nature of the planktonic eggs. Hardenberg further suggested the existence of two distinct races in *A. baganensis baganensis*, differing from one another in the number of gill rakers.

The distinguishing characters of the species under study are :—

(1) High and compressed body. (2) Presence of a small but distinct spine in front of the dorsal fin. (3) Two thin but distinct lines of small black pigment spots on the back from dorsal to caudal. (4) Maturity reached at a length of about 6 cm. (5) Ovarial egg oval, without knob. Characters 1-4 help to distinguish the species from *A. tri*.

Of the 70 specimens obtained from Kakinada, 38 forms correspond to *Stolephorus* (*Anchoviella*) *baganensis baganensis* Hardenberg ; the remaining 32 forms, and the 53 specimens obtained from Waltair differ markedly from either of the subspecies reported by Hardenberg, and may have to be considered as forming a distinct and new subspecies.

The following are the main meristic characters

Character	Range
1. Pectoral *f.r.* ..	11–14
2 Dorsal *f.r.* (excluding spine) ..	14–17
3. Anal *f.r.* ..	19–23
4. Gill rakers (lower arm) ..	22–28
5. Vertebræ ..	38–41

These two subspecies obtained by us can be easily distinguished externally, and the meristic characters confirm this separation.

External characters of the two subspecies

A *A. baganensis baganensis*	B *A. baganensis subsp. nov.*
1. Specimens are pale cream in colour, and covered with scales that are retained even after preservation	1. Specimens are relatively darker with scales that fall of easily on preservation
2. The pigment lines from dorsal to caudal are not so dark as in B	2. The two pigment lines are jet black
3. Delicate pigmentation on the back from head to dorsal	3. Such pigmentation almost absent
4. Maturity is reached even before attaining a total length of 6 cm.	4. Maturity reached only after 6 cm.

Meristic characters of the two subspecies

	Character	*A. baganensis baganensis* n 38	*A. baganensis subsp. nov.* Kakinada n 32	Waltair n 53
1	Dorsal *f.r.* (excluding spine)	14·79	15·50	15·66
2	Anal *f.r.* ..	21·42	20·72	20·29
3	Gill rakers (lower arm)	26·21	23·60	23·28
4	Vertebræ ..	38·79	39·78	39·54

The differences between the Kakinada and Waltair forms of the new subspecies are not statistically significant, and may be attributed to geographical variation. The differences in the means of the gill rakers and vertebræ of the two subspecies are particularly noticeable.

The name *Anchoviella baganensis bengalensis* is proposed for the new species in view of its

first being reported from the Bay of Bengal.

Details will be published elsewhere.

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ON THE BIOLOGY OF *APANTALES OBLIQUA* (WILK.), A LARVAL PARASITE OF *DIACRISIA OBLIQUA* (WLK.)

Diacrisia obliqua (Wlk.), belonging to the family *Arctiidæ* is some times very destructive to pulses, vegetables and fibre crops in Bihar. Field survey on this pest revealed that a certain percentage of the caterpillars of this insect were found parasitized by *Apantales obliqua* (Wilk.).

Wilkinson (1928) first described the species *Apantales obliqua* while revising the Indo-Australian species of the genus *Apantales*. Beeson and Chatterjee (1935) recorded it as a parasite on the caterpillars of *D. obliqua*, *Amsacta* spp. and on other *Arctiidæ* in the Punjab and Dehra Dun. Bhatnagar (1948) studied and described the morphology of the head and thorax of *Apantales obliqua*. With a view to study the potentiality of this parasite in the biological control of *D. obliqua*, preliminary studies on the biology of the parasite were carried out.

A stock culture of this parasite was successfully maintained in the insectory during the period from August to February 1957–58. On emergence of the adult parasites from the cocoons, the male and female parasites were separated and each pair was confined in a test tube with mouth covered with thin muslin for allowing aeration and with a layer of moist sand at the bottom. A known number of laboratory bred second instar caterpillars of *D. obliqua* along with a small piece of green castor leaf were introduced in each test tube for parasitization. The caterpillars were left with the parasites during the day and were transferred to wire-gauze cages in the evening and fed with fresh green leaves each day till their death. The parasitic cocoons obtained from these caterpillars were separated and transferred to separate test-tubes.

The adults of *Apantales obliqua* were found to mate within 10 to 12 hours after emergence, after which the female parasites usually search for suitable larvæ for oviposition. As soon as a suitable host is located, the female parasite approaches the host larva by bending her body at a right angle and inserts her ovipositor through the larval cuticle for oviposition. One female parasite was found to lay eggs in the same host for more than once. First and second instar caterpillars of *D. obliqua* were preferred by the parasite for oviposition. Examination of the freshly infected larvæ revealed that 10-15 eggs were deposited at a time by a female parasito. Five to seven depositions were usually made by a female parasite inside the larval cuticle of the same larva or different larvæ before her death. The minimum number of caterpillars parasitized by single female parasite during her life-time was 8 while the maximum number was 15. The total number of cocoons obtained from 8 and 15 parasitized caterpillars were 55 and 91 respectively. The total number of eggs laid by a female parasite during her life-time varied between 61 to 103 eggs. In the laboratory, the longevity of the adult female parasite ranged between 3 to 7 days.

The freshly laid eggs are spindle-shaped, creamy white and smooth and measure about 0·04 mm. On hatching, the parasitic larvæ feed on the lymph and fatty tissues of the host and complete their larval development inside the body of the host. When full grown, they exit through the ventro-lateral body region of the host larva. The parasitic grub is yellowish white and possesses lateral protuberances on either side of its body and measure about 5 mm. in length. A thin bladder-like appendage about 0·5 mm. in length is present at the posterior end of the last abdominal segment. Immediately after exit from the host, each grub begins to spin a white silken cocoon round itself and soon a compact mass of milky white cocoons appear on the sides of the host larva. All the parasitic grubs usually do not make their exit from the body of the host in one day but continue to exit for 2 to 3 days. The pupa inside the white cocoon is brownish grey in colour and measures about 4 mm. in length. The adult emerges by cutting a circular lid at the end of the cocoon. The total duration of the life-cycle was 16·2 days during February to March and 24·5 days during November to January.

The percentage of parasitization in the caterpillars of *D. obliqua* ranged between 5·27 to 19·63 in the field during August to March and was found to be highest during the month of November. The parasitic cocoons collected from

the field during the month of February failed to produce adults till next July which evidently indicates the possibility of the parasite æstivating in the pupal stage inside the cocoon during summer months.

In literature, there is no information available on the biology of *Apantale obliqua*. The findings of this paper, bring to light two significant facts on the biology of *A. obliqua*: firstly, the high biotic potential of the female parasite and secondly, the ability to æstivate in the pupal stage during summer months in Bihar. Further studies on the factors controlling æstivation and active phase of the parasite are still in progress.

The author wishes to express his gratitude to Dr. R. H. Richharia, Ph.D. (Cantab.), Principal, for providing necessary facilities in the Post-graduate Laboratory for carrying out the investigations.

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CHROMOSOME STUDIES IN SOME MEMBERS OF CHILOPODA (CLASS: MYRIAPODA)

THE Chilopoda is represented by a number of genera and species with wide distribution but the cytology of the group has received scant attention. Ogawa[1–6] has studied the chromosome number in eight species belonging to six genera: *Scolopendra subspinipes mutilans* (2*n* : 28); *Scolopendra s. japonica* (2*n* : 18); *Otocryptops rubiginosus* (2*n* : 27); *Otocryptops sp.* (2*n* : 22); *Bothropolys asperatus* (2*n* : 38); *Esastigmatobius longitarsis* (2*n* : 20); *Thereuonema hilgendorfi* (2*n* : 36); and *Thereupoda clunifera* (2*n* : 36). He describes a clear case of XY-type of sex-mechanism in the males of the genera *Thereuonema* and *Thereupoda* and presumes the existence of an XO-mechanism in the males of *Otocryptops rubiginosus*. In regard to the Scolopendridæ, Ogawa[4] observes that the sex-chromosome mechanism is unknown. According to Makino and Niiyama[7] the diploid number in *Scolopendra damnosa* is 28 but here again the sex-chromosome mechanism is unknown. The present note embodies observations made on the number and structure of the chromosome, nature of the kinetochore and sex-chromosome mechanism in some Indian Chilopods.

Nine species belonging to six genera and three families have been investigated (see Table I). In all cases the sex-chromosome mechanism is of the XY-type in the male. There is a localised kinetochore.

TABLE I

Species	Chromosome number 2*n*	*n*
Sub-order: Scolopendromorpha Family: Scolopendridæ		
1. *Scolopendra morsitans* Linn. ..	24	12 (I, II)
2. *Rhysida lithobioides* Newport ..	18	9 (I, II)
3. *Rhysida nuda* Newport ..	18	9 (I, II)
4. *Rhysida* sp. ..	16	8 (I, II)
5. *Cormocephalus pygmæus* Pocock	20	10 (I, II)
6. *Ethmostigmus* sp. ..	18	9 (I, II)
Sub-order: Geophilomorpha Family: Geophilidæ		
7. *Mecistocephalus punctifrons* Newport	26	13 (I, II)
Sub-order: Scutigeromorpha Family: Scutigeridæ		
8. **Scutigera* sp. ..	36	18 (I, II)
9. **Scutigera* sp. ..	36	18 (I, II)

* The two species differ in their ecology, colour and body-size.

The details of spermatogenesis of the forms included in this study will be published elsewhere.

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EMBRYONY IN LOQUAT (*ERIOBOTRYA JAPONICA* LINDL.)

POLYEMBRYONY has been recorded in the fruit plants like *Citrus* spp., *Mangifera* spp., *Poncirus trifoliata* Raf. and *Syzygium* spp.[3] It has also been reported in loquat.[1] Observations of the germinating seedlings of loquat, however,

showed no such phenomenon. It was, therefore, decided to study the occurrence, extent and varietal response of different loquat cultivars to polyembryony.

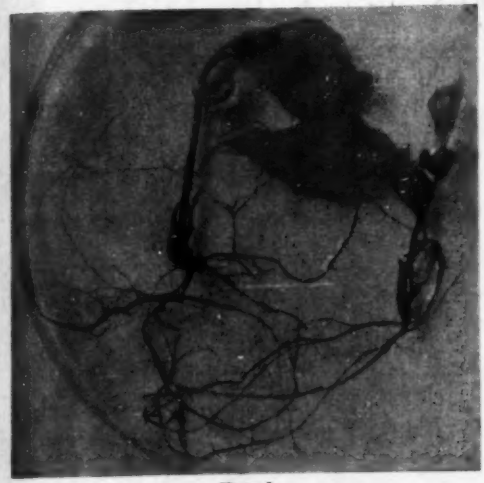

FIG. 1

The cultivated varieties taken for this study were Golden yellow, Improved golden yellow, Pale yellow, Improved pale yellow, Fire ball, Large Agra, Long white, California advance, Tanaka and Hord's mammoth. Fifty seeds from each of these varieties were dissected to find out the number of embryos present in the seed and the other lot of 100 seeds each was sown in pots to detect multiple seedlings, if any. None of the dissected seeds showed more than one embryo, which was further manifested in the production of single gametic seedlings from a seed. A number of germinating seedlings, however, showed multiple shoots, a phenomenon also reported in case of Indian mangoes (*Mangifera indica* L.).[4] The plants exhibiting multiple shoots had only one root while for polyembryonic seedlings there should be as many roots as there are shoots. The frequency of such shoots is given in Table I.

TABLE I

Number of multiple shoots in different cultivars of loquat

Sl. No.	Cultivars	No. of seeds germinated out of 100	Number of plants having multiple				% of seeds showing multiple shoots
			2 shoots	3 shoots	4 shoots	5 shoots	
1	Golden yellow ..	82	7	4	1	1	15·85
2	Improved golden yellow	80	7	1	0	0	10·00
3	Pale yellow ..	76	5	3	0	0	10·53
4	Improved pale yellow	93	6	4	1	0	11·83
5	Fire ball ..	81	16	5	1	2	29·63
6	Large Agra ..	69	10	3	0	0	18·84
7	Long white ..	75	0	0	0	0	00·00
8	California advance	85	6	3	0	6	10·59
9	Tanaka ..	67	3	1	0	0	5·97
10	Hord's mammoth	94	13	10	1	0	25·53
	Average ..	80·2	7·3	3·4	0·4	0·3	13·877

Table I shows that on an average only 13·87% seedlings showed multiple shoot formation. Long white variety exhibited no such phenomenon while the Fire ball variety had the maximum percentage (29·63).

Thus, contrary to the observations of Bajpai,[1] the present studies show that there is no polyembryony in loquat.

ACKNOWLEDGEMENT

I acknowledge my sincere thanks to Dr. L. B. Singh for valuable guidance and to Dr. R. N. Singh for going through the manuscript and for constructive criticism.

Horticultural Research Institute, Saharanpur,
October 17, 1958.

UDAY PRATAP SINGH.

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CYTOLOGY OF SOME HIMALAYAN MOSSES

IMPORTANT cytological contribution on wild populations of various Finnish,[1,2] North American,[3–5] Japanese[6–8] and British[9] mosses have appeared in recent years. But no such account exists for the Indian mosses except a few fragmentary reports. With this in mind the present study was undertaken with particular reference to the family Pottiaceæ, one of the well represented moss families in the Himalayas. The material was studied at meiosis during the monsoons of the years 1956-57 at Mussoorie

(6,500 ft. W. Himalayas) following the usual acetocarmine squash technique. Though a larger number of the species have been worked out the present report (Table I) contains only those for which no previous cytological record is available.

TABLE I

Name of the species	Meiotic chromosome number
DICRANACEÆ :	
1. *Dicranella cmodi-varia* C. Müll...	15
2. *D. mollicula* (Mitt.) Jaeg. ..	15
3. *Trematodon capillifolius* C. Müll.	15
POTTIACEÆ :	
*4. *Molendoa roylei* (Mitt.) Broth...	13
5. *Barbula flavescens* (Hook. & Grev.) Brid.	13
6. *B. constricta* Mitt. ..	13
7. *B. ehrenbergi* (Lor.) Fl. ..	13
*8. *Gymnostomum calcarum* Nees & Horn.	13
9. *G. recurvirostrum* Hedw. ..	13
10. *G. auranticum* (Mitt.) Par. ..	13
*11. *Hymenostylium curvirostre* (Ehrh.) Lindb.	13
*12. *Reimersia inconspicua* (Griff.) Chen	13+f
*13. *Anœctangium thomsonii* Mitt. ..	13
14. *A. strachythecianum* Mitt. ..	13
*15. *Brvœrythrophyllum atrorubens* (Besch.) Chen	13+f
16. *B. walkchii* Mitt. (Chen) ..	13
17. *Timmiella anomala* (B. & S.) Schimp	15
*18. *Hyophila involuta* (Hook.) Jaeg.	13
*19. *Merceya gedeana* (Lac.) Noguchi	13
20. *Weisia crispa* (Hedw.) Mitt. ..	13
GRIMMIACEÆ :	
21. *Grimmia commutata* Huebn. ..	13
BARTRAMIACEÆ :	
22. *Bartramia subpellucida* Mitt. ..	8
23. *Philonotis heterophylla* Mitt. ..	6
24. *P. griffithiana* (Wils.) Mitt. ..	6
LEUCODONTIACEÆ :	
25. *Leucodon secundus* (Harv.) Mitt.	9

The report of the chromosome number for 8 genera marked * and all the species appears for the first time.

A detailed account concerning cytotaxonomy, behaviour and properties of sex and accessory chromosomes, polyploidy, etc., will be presented elsewhere.

The writer is deeply indebted to Prof. P. N. Mehra for valuable criticism and many useful suggestions and Messrs. R. S. Chopra and T. N. Khoshoo for their keen interest in the work. He is also thankful to Mr. A. H. Norkett of the British Museum, London, for the help with the identification of the specimens.

Botany Department, K. R. KHANNA.
Panjab University,
Amritsar, India,
September 27, 1958.

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OCCURRENCE OF FASCIATED FRUITS IN *CAPSICUM*

A CASE of three fruits arising from a common pedicel was spotted by the author during 1957 in Kurnool District in a stunted *Capsicum annuum* plant. There is a common stalk and a common cup-shaped calyx as in the case of normal fruits but with three separate fruits attached to this stalk. The dried up pedicel showed distinct strands indicative of fasciation.

In *Capsicum annuum* also, cases of two fruits occurring at a node have been recorded. There is also a bunch mutant reported. This freak may be one of fasciation of three fruits in a bunch type. The seeds have been extracted to raise the progeny to find out whether the parent was a bunch-mutant.

Agricultural Research Station, P. NAGESWARA RAO.
Nandyal R.S. & P.O.,
September 25, 1958.

ARGINA CRIBRARIA CLERCK, A PEST ON SUNNHEMP IN MADRAS STATE

Argina cribraria, Clerck (Fam. Hypsidæ, Lepidoptera),[1] is a caterpillar pest which does extensive damage to Sunnhemp (*Crotalaria juncea*) in Madras State. About three broods were noted during the duration of the crop, June to November, in the field. Lefroy (1909) mentions it as a serious pest feeding mainly on the leaves of *Crotalaria juncea*. It has since been found to have a number of other host plants such as *Crotalaria sericea*, *C. salitana*,

C. retusa, *C. anagyroides* and *Calapagonium corensis*. In severe cases of attack, leaves, pods, and flowers are eaten away.

FIG 1. Life-history stages of *Argina cribraria*, Clerck. (*a*) Egg. (*b*) Caterpillar. (*c*) Pupa. (*d*) Adult.

Life-history.—Eggs are laid in small clusters on the undersurface of leaves. The larva passes through five instars and pupates at its sixth moult. The larval period lasts 18 to 21 days. Pupation takes place on the plant or on the surface of the soil. The pupal period ranges from 6 to 7 days. The total life-cycle is about 26 to 31 days.

The results of trials with synthetic chemicals to control the pest clearly indicated that the pest could be effectively checked either by dusting 5% BHC or spraying 0·1% Dieldrin.

The author wishes to express his gratitude to the Government Entomologist for facilities afforded during the investigation.

Agricultural Department, Madras,
November 6, 1958.

S. VENUGOPAL.

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OCCURRENCE OF CYTOPLASMIC MALE-STERILITY IN PEARL MILLET (*PENNISETUM TYPHOIDES* STAPF AND HUBB.)

VARIED manifestations of the influence of cytoplasm in heredity have been revealed by recent investigations.[2,5,6] Cytoplasmic male-sterility has been reported in different plants and it has been found to be a useful tool for the plant breeder in the large-scale production of hybrid seed in crops where heterosis is exploited for improvement of yield.[3]

Among the collection of varieties of pearl millet studied at the Millet Breeding Station, a high frequency of male-sterile plants was observed in 1949, in open-pollinated populations of one, *viz.*, P.T. 819 (Sajja from Bellary District, Mysore State, India). The male-sterile plants had underdeveloped anthers, which contained only an agglutinated mass of empty pollen. They failed to dehisce and dried up much earlier than the normal fertile ones. No meiotic abnormalities were observed in the P.M.C.s. In selfed panicles of male-sterile plants there was no seed-setting, while in open-pollinated or artificially pollinated panicles seed-setting was full indicating complete fertility of ovules.

Choosing male-sterile plants from P.T. 819 as female parents, seven crosses were effected in 1950, with pollen collected from single plants of inbred lines breeding true for male-fertility and unrelated to P.T. 819, and also from fertile plants of P.T. 819. Of the four crosses with unrelated pollen parents, two gave only male-sterile plants in the progeny, while in the other two, segregation for fertile and male-sterile plants was observed. The progenies of the three crosses with fertile plants from P.T. 819 segregated male-sterile and fertile plants. The F_1 plants of the families which gave only male-sterile progeny (P.T. 819 Male-sterile × P.T. 732/5 and P.T. 819 Male-sterile × P.T. 837/7) were backcrossed to single plants of normal true-breeding fertile inbred lines unrelated to P.T. 819. The progenies of these 22 backcrosses were interesting in that 13 of them showed only male-sterile plants, while two had only fertile plants and the other seven segregated male-sterile and fertile plants in a 1 : 1 ratio.

The behaviour of some of these backcross progenies in giving only male-sterile plants or only fertile plants pointed to the cytoplasmic influence in the inheritance of male-sterility. Reciprocal crosses were, therefore, effected between fertile plants of P.T. 819 and the true-breeding fertile inbred line P.T. 732/5 which gave only male-sterile progenies in backcrosses with male-sterile plants. The individuals involved in each cross were used both as male and female parents, taking advantage of the tiller panicles, so as to avoid the differences that might arise due to the heterogeneity of the parental populations. The progenies as indicated in Table I clearly demonstrated the reciprocal differences.

TABLE I

Female parent	Male parent	No. of families	Progeny		
			Fertile	Male-sterile	Total
P.T. 732/5 (Fertile)	× P.T.819 (Fertile)	6	1020	..	1020
" 819 "	× " 732/5 "	6	474	460	934
" 732/5 "	× " 819 "	1	114	..	114
" 819 "	× " 732/5 "	1	100	..	100

For confirmatory evidence, one of the male-sterile cultures [P.T. 819 (male-sterile) × P.T. 732/5] was continuously backcrossed to its fertile male parent, P.T. 732/5 with a view to effect gene substitution. The backcrossing was done in successive years from 1951, selection being exercised in the progeny for paternal characteristics. Their behaviour in successive generations is given in Table II.

TABLE II

Backcross generation	No. of families	Progeny			
		Fertile	Partially male-sterile	Male-sterile	Total
I	1	..	..	89	89
II	1	..	..	75	75
III	2	..	..	54	54
IV	7	..	..	591	591
V	6	..	8*	512	520

* Observed only in two families.

The persistence of male-sterility in all the plants of the different progenies after continued backcrossing (except for the very few partially male-sterile plants with occasional fertile anthers amidst sterile ones, observed in two families in the fifth generation), was conspicuous, even though in most other morphological characteristics the backcrossed plants resembled the male parent. It was thereby clear that the nuclear genes contributed by P.T. 732/5 were ineffective in producing pollen fertility in plants with cytoplasm derived from P.T. 819, which is specifically different from that of P.T. 732/5 and maintained its characteristic in spite of substitution of the nuclear genes of P.T. 732/5.

It was, however, seen that in some of the backcrosses of the male-sterile F_1 to true breeding fertile inbred parents, complete restoration of fertility occurred, while others segregated male-sterile and fertile plants. These simple segregations indicate that the male parents used in the backcrosses were heterozygous for a major nuclear gene, the dominant allelomorph of which could restore fertility in P.T. 819 cytoplasm. These facts are also borne out by the reciprocal crosses wherein segregation into male-sterile and fertile plants was observed in progenies having P.T. 819 as female parents. The nature of action of the nuclear genes of P.T. 732/5 in P.T. 819 cytoplasm being evident from the continued backcrosses, the segregation in the progeny of these reciprocal crosses should have resulted from the heterozygosity of the female parents for fertility restorer factors. If inheritance of the character was solely controlled by nuclear factors, the progenies of the reciprocal crosses should have been identical and if nuclear genes had no effect, the segregation of fertile and male-sterile plants in the backcrosses could not have been noticed. It is, therefore, evident that the male-sterility observed in P.T. 819 is dependent on an interaction between nuclear and cytoplasmic factors. The differential action of the genes is expressed in the phenotype, only in the P.T. 819 cytoplasm, but not in the cytoplasm of other fertile true-breeding inbred lines derived from unrelated varieties like P.T. 732/5.

The utilization of cytoplasmic male-sterility in the breeding programme for the exploitation of heterosis in the pearl millet can obviate the limitations experienced in the large-scale production of hybrid seed by the methods in vogue. Kajjari and Patel[4] described a male-sterile plant but presented no evidence as to the mode of inheritance. Recently, however, Burton[1] reported the occurrence of male-sterile plants in crosses between inbred lines of this millet and suggested the mode of inheritance to be cytoplasmic. Successful use of the male-sterility described above is being made by continuous backcrossing to some superior inbred lines maintained at the station. The existence of a good number of inbreds with fertility restorer genes is a highly favourable factor. Detailed investigation on these aspects has been progressing and will be reported elsewhere.

Millets Breeding Station, P. MADHAVA MENON.
Agricultural College and
Research Institute,
Coimbatore, *October* 15, 1958.

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CONTROL OF CITRUS CANKER WITH ANTIBIOTICS

THE effect of streptomycin sulphate in controlling canker disease of citrus, caused by *Xanthomonas citri* (Hasse) Dowson, is being reported elsewhere by the authors.[1] The antibiotic when sprayed in aqueous solutions at 500 and 1,000 p.p.m. together with 1% glycerin was found to be absorbed within eight hours by the leaves and persisted in the tissues up to 21 days. Spraying the chemical at 15-day intervals checked the disease spread on three-year old acid lime [*Citrus aurantifolia* (Christm.) Swingle] plants. In the present communication results obtained from subsequent field tests carried out to compare more antibiotic preparations for controlling citrus canker are reported.

The experiment was laid out in a commercial orchard in Pinnalur, South Arcot District. A block of 48 five-year old acid lime plants was selected for the purpose. The plants were treated by randomized replicated experimental design, with six treatments and eight replications. The samples of Phytomycin, an agricultural spray material containing 20% streptomycin nitrate as active ingredient, which has been reported to be effective against several bacterial diseases of crop plants in U.S.A.,[2–4] and Thiostrepton, another antibacterial antibiotic, were obtained from the Squibb Institute for Medical Research, New Brunswick, N.J., U.S.A. A pharmaceutical grade of streptomycin sulphate with 740 units/mg. (Glaxo Laboratories) was used in the experiments. 1% Bordeaux mixture was prepared in the usual manner and sprayed for comparison. The methods of recording and evaluation of disease intensity were essentially the same as was detailed earlier.[1] The chemicals were sprayed in aqueous solutions with 1% glycerin, using a Primus sprayer, at fortnightly intervals. Infection counts were taken prior to each spraying and the results are represented graphically in Fig. 1.

At the commencement of the experiment, early in August, there was severe canker infection on the plants, but soon after there was heavy reduction in the disease intensity in all plants

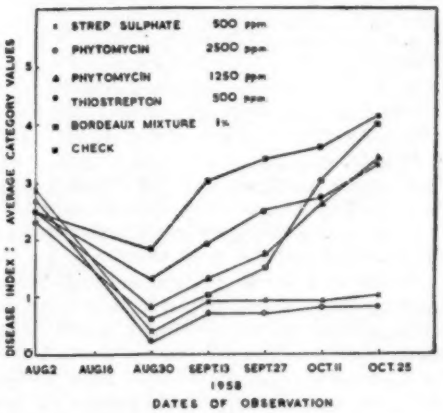

FIG. 1. Effect of antibiotics on citrus canker: Disease incidence expressed as category values.* *Grading and category values used are: No infection = 0; 0–10% = 1; 10–30% = 2; 30–50% = 3; 50–75% = 4; > 75% = 5.

S.E.	..	0·34
C.D. at 5% level	..	0·67

due to leaf drop. With the new flush by the end of August the disease started spreading rapidly in the orchard. Among the treatments, Phytomycin † (2,500 p.p.m.) and streptomycin sulphate checked down considerably the progress of the disease, while the others were not much effective (Fig. 1). In the case of Bordeaux mixture spray, there was initial heavy reduction in disease intensity due to leaf drop, but subsequent growth of new flush was arrested for some period. When the new flush was on in September-October the disease became almost as severe as in the check plants.

The authors are thankful to Messrs. Squibb and Son, for the supply of Phytomycin and Thiostrepton used in these studies.

Dept. of Agriculture, G. RANGASWAMI.
Annamalai University, RAO RAMA RAO.
Annamalainagar (S. Arcot), AR. LAKSHMANAN.
November 18, 1958.

† Phytomycin at 1,250 p.p.m. however did not have any effect.

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SIMARUBACEOXYLON MAHURZARI GEN. *ET* SP. NOV., A NEW FOSSIL WOOD FROM THE DECCAN INTERTRAPPEAN BEDS OF MAHURZARI

THE present note deals with a fossil dicotyledonous wood from the Deccan Intertrappean beds of Mahurzari, a village about 8 miles from Nagpur. Large number of pieces of petrified dicotyledonous woods have been collected from this locality.

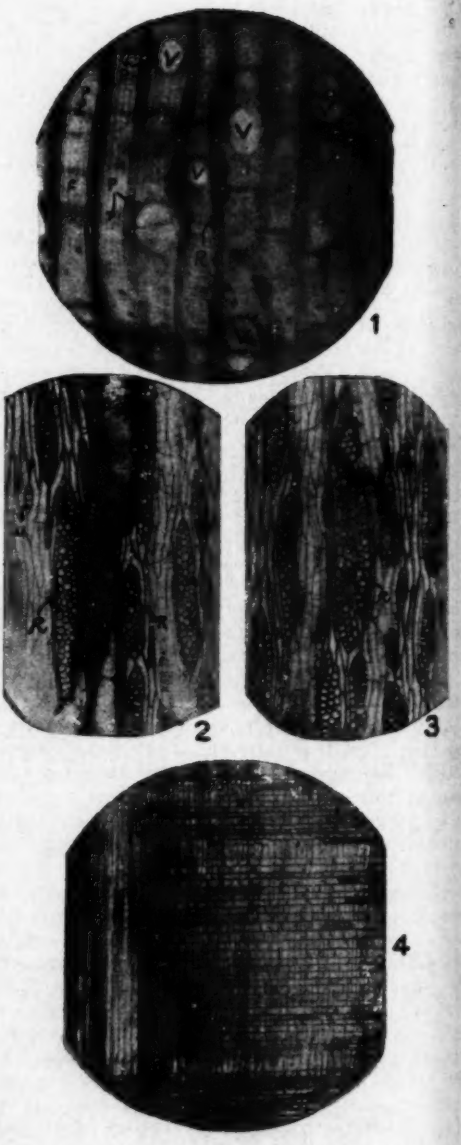
The present specimen is a big silicified piece of secondary wood with fairly good preservation. The natural reddish stain of the petrifactions made the study of the wood easy.

It is medium coarse textured and distinctly diffuse porous wood; growth marks faint. Vessels visible when seen with hand lens; medium-sized, the radial and tangential diameters being 150 to 200 μ and 100 to 150 μ respectively; evenly distributed; solitary or in radial rows of two (Fig. 1); usually filled with tyloses. *Intervessel pits* alternate and bordered (Fig. 2). *Parenchyma* fairly abundant about the pores, lateral extensions present (Fig. 1). *Rays* broad to fine; the broad rays conspicuous, homogeneous (Fig. 4) consisting of procumbent cells of various sizes (Figs. 2, 3, & 4); 2 to 7 cells and 50 to 150 μ in width and 1 to 70 cells and 60 μ to 1,600 μ in height; the fine rays uniseriate, again homogeneous, made up of procumbent cells (Fig. 2), interspersed with broad rays. *Fibres* non-libriform, somewhat angular in cross-section with fairly large lumen, non-septate with bordered pits.

Comparisons of the fossil wood are drawn up with dicot families Rutaceæ and Simarubaceæ. There is no outstanding feature in the fossil wood which, if considered alone, would help in its identifications. The author has therefore adopted a well-known method of taking the combination of characters and going through all the dicot families. The combination of characters is well met in family Simarubaceæ. The comparisons are drawn up with two living genera, *Ailanthus* and *Simaruba*[1-2] in particular. Further investigations on the generic identification of the fossil are being carried out and results will be published later.

A form genus has been established to accommodate the fossil. The name *Simarubaceoxylon* has been used in the sense that the fossil wood belongs to family Simarubaceæ.

I am indebted to Dr. (Mrs.) S. D. Chitaley of College of Science, Nagpur, Shri S. S. Ghosh and Shri M. H. Kazmi of Forest Research Institute,



FIGS. 1-4

FIG. 1. Transverse section showing distribution of vessels (V), rays (R) and parenchyma (P), ×45. FIGS. 2 & 3 Tangential sections showing ray characteristics (R). Note the uniseriate ray (U) in Fig. 2. ×45. FIG. 4. Radial section showing clearly the homogeneous condition of the rays, ×45.

Dehra Dun, and Shri B. G. L. Swamy for their valuable guidance and helpful suggestions.

Botany Department, L. J. SHALLOM.
College of Science,
Nagpur,
October 11, 1958.

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SEED-LEAF INJURY DURING GERMINATION IN COTTON

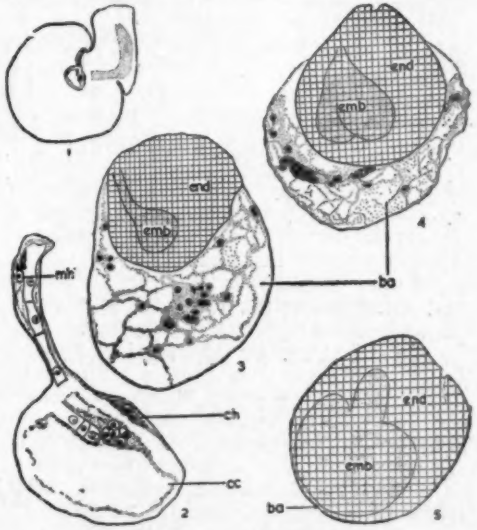
CLOSE observations on three week old seedlings in a bulk crop of MCU—2 cotton on the Cotton Research Farm. Srivilliputhur, Madras State, during 1957, showed that in 18 out of a random sample of 100 seedlings the seed-leaf was not perfect in outline. One of the leaves showed signs of a mechanical injury at the margin corresponding to the place of final release from the grip of the ruptured testa shrinking in the process of germination. In most cases part of the white papery membranous relic of the endosperm was also found attached on the adaxial surface of the cotyledon. In stray cases a halo of anthocyanin developed along the fringe of the damaged tissue. This localisation of the injury would appear to be a case of tramautic response as a consequence of tardy disentanglement of the seed-leaf and a rapidly dehydrating testa. The injury was not due to entomological or pathological cause as one was apt to judge on cursory observations. It did not inhibit further development of the seed-leaf. This observation is let in to show that this is a new congenital defect which may show varietal incidence and as far as the authors are aware, it has not been recorded before in this country, or in any other country.

Madras Agricultural Department, L. NEELAKANTAN. V. SIVASUBRAMANIAN.
Lawley Road,
Coimbatore,
October 9, 1958.

ENDOSPERM IN *ERANTHEMUM NERVOSUM*

THE mode of endosperm formation in the family Acanthaceæ is unique. With the exception of *Thubergia* (Mauritzon[1]) all the acanthaceous plants so far investigated show an initial vertical row of three endosperm cells, also met with in some families of the Tubifloræ, like Hydrophyllaceæ, Boraginaceæ, Scrophulariaceæ and Lobiatæ. What characterises the development subsequent to the three-celled endosperm of the Acanthaceæ in the stage? The central cell alone produces the endosperm proper, while the other two cells are transformed into the micropylar and the chalazal haustoria respectively. Usually the haustoria are unicellular and contain two or four nuclei. The endosperm proper may be nuclear to begin with but ultimately becomes cellular, or it may be cellular from its very inception. In several genera cell formation in the nuclear endosperm may be restricted to the part surrounding the embryo, leaving below it a free nuclear zone—the basal apparatus (Mauritzon[1], Mohan Ram[2], Mohan Ram and Sehgal[3]). The latter shows a great degree of variation in its extent and activity.

To start with, the central endosperm chamber in *Eranthemum nervosum* shows a free nuclear condition (Figs. 1, 2). According to Mauritzon,[1]



Figs. 1 and 2 from microtome sections; Figs. 3–5 from dissected whole mounts.

FIG. 1. L.s. young seed, × 40. FIG. 2. Embryo-sac enlarged from Fig. 1 showing a long pro-embryo, a two-nucleate chalazal and micropylar haustoria and a five-nucleate central chamber, × 550. FIGS. 3–5. Later stages of endosperm. In Figs 3 and 4 a broad basal apparatus is observed. Fig. 3, × 180, Fig. 4, × 80 and Fig. 5, × 50.

ba, basal apparatus; *cc*, central chamber; *ch*, chalazal haustorium;
emb, embryo; *end*, endosperm proper; *mh*, micropylar haustorium.

in *E. leuconeuron* it becomes completely cellular after the 16-nucleate stage without forming a

basal apparatus. However, in *E. nervosum* it is found that wall formation is postponed until 32-64 free nuclei are formed, and a distinct basal apparatus always surrounds the cellular part of the endosperm (Figs. 3, 4). This is especially clear in dissections made under a stereoscopic microscope.

It may be pointed out that microtomed sections of young seeds always show a large empty space around the cellular endosperm. This represents the basal apparatus which is eventually used up by the enlarging cellular endosperm (Fig. 5).

It seems probable that in *E. leuconeuron* also, a basal apparatus similar to that of *E. nervosum* is present. Mauritzon's failure to observe it appears to be due to studying microtome sections alone which tend to give an incomplete picture unless supplemented by dissections and whole mounts.

Prof. P. Maheshwari's suggestions are gratefully acknowledged.

Department of Botany, H. Y. Mohan Ram.
University of Delhi,
December 3, 1958.

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2. Mohan Ram, H. Y., *Proc. 43rd Indian Sci. Congr.* (Agra), 1956, 135.
3. — and Sehgal, P. P., *Phytomorphology*, 1958, **8**, 124-36.

THE OCCURRENCE OF A SYMPHYLID (CLASS: MYRIAPODA) AS A PEST OF SUGARCANE AT COIMBATORE

Various soil animals are known to damage roots of crop plants. Ingram[3,4] reported the occurrence of *Hanseniella unguiculata* Bagnall, a symphylid, along with certain other kind of soil animals in Louisiana sugarcane fields, causing root injury to sugarcane plants.

Spencer and Stracener[1,2] observed extensive root injury to sugarcane by various soil organisms and demonstrated experimentally that root injury known as "Pitting" could be produced by the Symphylid, *Symphylella* sp.

In the course of a search for soil pests responsible for the heavy mortality of sugarcane seedlings (30 to 40%) in flats at the Sugarcane Breeding Institute, Coimbatore, the author ran into large numbers of a white symphylid in the soil surrounding the root zone of seedlings in the specially constructed brick flats on which the seedlings are raised. The examination of the root system revealed root damage in the form of 'pits' on the roots. The symphylids were actually seen to "gnaw" at the roots and tender root hairs (Figs. 1 & 2).

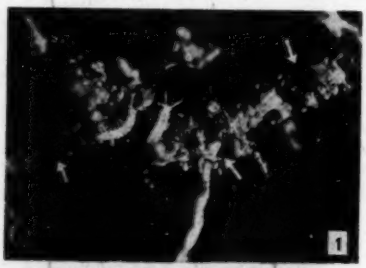

FIG. 1. Symphylids *in situ*: Feeding on roots of sugarcane (arrows denote damaged portions of root).

FIG. 2. Roots of sugarcane showing fresh damage in the form of "pits".

As far as the author is aware, this appears to be the first record of a symphylid affecting sugarcane in India. This is of particular importance to this Institute, which raises millions of hybrid sugarcane seedlings every year and which experiences a heavy loss of valuable seedlings in the nursery stage itself due to various factors including soil pests.

My thanks are due to Dr. N. R. Bhat, Director, and Shri R. A. Agarwal, Entomologist, for their keen interest in the work.

Sugarcane Breeding Institute, G. N. Rao.
Post Lawley Road,
Coimbatore,
November 1, 1958.

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A NEW SPECIES OF *CILIOCHORELLA* ON *EUCALYPTUS GLOBULUS* L.

DURING the month of July 1958, the writer collected a fungus occurring as a saprophyte on dried leaves of *Eucalyptus globulus* L. On microscopic examination the fungus was identified as *Ciliochorella* which was first established by Sydow and Mitter (1935). Since this fungus was observed for the first time in the Bombay State and collected on a hitherto unreported host, a critical study was undertaken. A comparison between the Poona species of *Ciliochorella* and the type, *Ciliochorella mangiferæ* Syd. as emended by Subramanian and Ramakrishnan (1956) is presented in Table I.

TABLE I

Species	Pycnidia (diameter)	Conidia	Lateral appendage	Basal appendage
	(mm.)			
C. mangiferæ Syd.	up to 2	29–39 × 2·6–3·3 μ	11–20 μ	4–9 μ
Poona species ..	up to 1	8·5–18·7 × 1·7–2·6 μ	17–28 μ	3–9 μ

It is evident from a study of Table I that the Poona species is quite distinct from *Ciliochorella mangiferæ* Syd. in several respects, possessing smaller pycnidia, and conidia and longer lateral appendages. The Poona species is, therefore, described as a new species of *Ciliochorella*.

Ciliochorella EUCALYPTI VISWANATHAN SPEC. NOV.

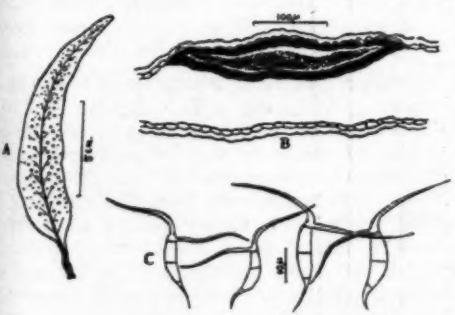

FIG. 1. A. leaf of *Eucalyptus globulus* L. showing infection spots. B. Section of pycnidium; C. Conidia.

Pycnidia amphigena, nigra, circularia, dispersa, dimidiata, intraepidermalia, astoma, patentia per fissuras, unilocularia, parietibus pseudoparenchymaticis. Conidiophori bulbosi, breves, surgentes e stromate basali; conidia hyalina, dorsiventralia, paulisper curvata, 4-cellulata, cylindrica in medio, fastigata ad utrumque apicem, 8·5–18·7 = 1·7–2·6 μ; cellula apicalis desinit in caudam longam, curvatam, hyalinam, filiformem, atque supportat in latere concavo prope basin appendicem longam, hyalinam, lateralem magnit. 17–28 μ; cellula basalis fastigatus in appendicem hyalinam, tenuem, vulgo curvatam, 3–9 μ longam.

In foliis emortuis *Eucalyptus globuli* L. ad Poona in India a T. S. Viswanathan, mense julio anni 1958.

While originally Sydow and Mitter (1935) described the spores of the type fungus as one-celled and the basal appendages as stalks, Subramanian and Ramakrishnan (1956) have recently published an emended account of the type describing the spores as 4-celled and the "stalks" of Sydow and Mitter as the basal appendages. Chona and Munjal (1955) describe the spore as 2-celled and the apical and basal portions as part of appendages. A critical study made by the writer both of this species as well as the type on *Mangifera indica* L. showed that the apical and basal portions took the aqueous cotton-blue stain readily leaving the filamentous portion unstained, thus proving the validity of Subramanian's and Ramakrishnan's description of the spores as 4-celled.

Besides being a new species, the fungus constitutes a new record for the Bombay fungi.

The type specimens have been deposited in Herbarium Cryptogamæ Indiæ Orientalia, New Delhi, India and the Herbarium of the Commonwealth Mycological Institute, Kew, England.

The author is very grateful to Prof. M. N. Kamat for guidance, to Prof. S. P. Agharkar, Director, for facilities offered at this laboratory and to Rev. Father H. Santapau for the Latin rendering.

M.A.C.S. Laboratory, T. S. VISWANATHAN.
Law College Buildings,
Poona-4,
October 31, 1958.

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REVIEWS

Progress in Crystal Physics, Vol. I. *Thermal, Elastic and Optical Properties.* By R. S. Krishnan. (Published by S. Viswanathan, "Acton Lodge", Madras-31), 1958. Pp. vi + 198. Price Rs. 20.

The aim of this series, according to the author, is to make available critical reviews of the "available data on the physical properties of non-metallic crystals in a form most useful to the workers in Crystal Physics". The Department of Physics of the Indian Institute of Science, Bangalore, has been interested in these problems for the past several years and has itself contributed a good amount of data and theoretical work. The author, who is the present Head of this Department, is therefore particularly well fitted to undertake this work of reviewing the publications in the field.

The first volume, under review, consists of seven chapters respectively on Thermal Expansion, Thermal Conductivity, Elastic Constants, Photoelastic Effect, Thermo-optic Behaviour, Faraday Effect and Dielectric Properties, each one prepared by one or more of the workers in the Department together with Prof. R. S. Krishnan. There is a short introduction of 8 pages (probably far too short), dealing with elements of crystallography, method of growing crystals, number of various constants in the different crystal classes, etc.

Each chapter contains a short review of the main developments in the subject, followed by an exhaustive summary of the available data. In the review part, an attempt is made to mention not only the various experimental techniques available but also the theoretical implications of the results obtained. Obviously it is not possible to do justice to all this in a space of 20 pages or less. As a consequence, it is not possible for a reader unacquainted with the field to get familiar with it from reading this book. On the other hand, practically every paper of significance is mentioned and so the book forms an excellent source of reference to the workers in the field. In the collection of data also, no effort has been spared to make it complete and so the tables at the end of each chapter provide an exhaustive list of the available data. The authors and the editor have to be complimented on the very thorough manner in which they have done this.

A few minor criticisms may be made. There are a few errors in the Tables, *e.g.*, ψ for potassium chlorate is available in the original paper, but not given in Table IV (p. 38) ; so also the probable errors are omitted for boric acid, although reported in the original paper (p. 41). It would have been better if the angle ψ were defined uniformly in the article, say, as that between OX_1 and a, measured positive towards c, and all the data given according to this convention in the Tables.

A more serious criticism is the complete omission of all references to Raman's theory of elasticity, except a vague statement that it assumes "stresses and strains of a character different from those in the classical theory of Cauchy". The "molecular" theory of wave propagation in crystals as developed by Raman and Viswanathan, and independently by Laval, and tested at least in one case by Le Corre, is not even mentioned in the body of the review. The chapters on the optical and magneto-optic properties are particularly well written.

All these do not detract from the value of the book, which provides for the first time a comprehensive and readily available source book of the literature on the subject. It is warmly recommended to all libraries interested in crystal physics.

G. N. RAMACHANDRAN.

Biophysical Chemistry. By John T. Edsall and Jeffries Wyman. Vol. I. (Academic Press, Inc.), 1958. Pp. 699. Price $ 14.00.

Biological systems defined in terms of chemical molecules are by and large dominated by proteins and we seem to have gained some understanding of the connection between certain life processes and the associated chemical changes. The subtler connections, however, seem to be at the present moment beyond our comprehension. In recent years biology has contacted physics and even mathematics, and today we find a new borderline subject rapidly developing under the title Biophysics.

The present volume has much to say regarding the physico-chemical aspects of chemical components making up a biological system, of which we find a variety, namely, acids and bases, polar molecules, electrolytes, etc. Chemical reactions supply the biological system, as

long as it is endowed with life, with vital energy necessary for its function. Rightly, therefore, in this volume, a good number of pages are devoted to thermodynamics and its application to chemical reactions. Starting from fundamental principle and definitions, the authors take the reader to the applied aspect, namely, chemical thermodynamics.

The subject is presented under eleven headings :

Biochemistry and Geochemistry ; Water and its biological significance ; Problems of protein structure ; Thermodynamics ; Electrostatics : Its application to polar molecules and ionic solutions ; Dielectric constants and their significance ; Conductivity of electrolytes ; Acid-base equilibria ; Polybasic acids, bases and ampholytes, including proteins ; Carbon dioxide and carbonic acid ; Some general aspects of molecular interactions. A list of references cited at the end of the chapters will be found to be of much value for those who are interested to go deeper into the subject. The volume which is claimed by the authors to have been born out of a course of lectures on pysical chemistry of biochemical systems has been written mainly with the biochemists in mind. But the average biochemist may experience difficulty in following some of the chapters for they are inevitably bound up with a mathematical treatment. The book will serve as an introductory guide for the enterprising physical chemists who want to put their knowledge to use, in a fascinating field, whose mysteries are yet to be unfolded. The arrival of subsequent volumes on the subject will be awaited with much eagerness.

A. J.

Peace or Atomic War. By Albert Schweitzer. (Asia Publishing House, Bombay-1), 1958. Pp. 45. Price Rs. 3·00.

This booklet embodies three broadcast Appeals from Oslo, made in April 1958, by one of the most challenging personalities in the world today. Dr. Schweitzer, who has the unique distinction of having won Doctorates in four subjects, *viz.*, Philosophy, Theology, Music and Medicine, and who gave up the glittering prizes of life to become a medical Missionary in the jungles of Africa, has raised his powerful voice against nuclear tests and Atomic warfare. "Generation after generation, for centuries to come, will witness the birth of an ever-increasing number of children with mental and physical defects." Discussing the perils of an Atomic war, he quotes an American General as saying, "If at intervals of ten minutes, 100 H-bombs are dropped over the U.S.A., there would be a casualty list of 70 million people. Countries like England, West Germany and France could be finished off with 15 or 20 bombs". 9235 leading Scientists of all Nations have declared emphatically against the continuance of nuclear tests ; but the Atomic Powers lend their ears only to the reassuring and propaganda statements of their own scientific stooges. Quite recently, there have been reports of successful U.S. nuclear tests in outer space, and these will weave new deadly radiation belts round the Earth. The rate of radioactive Strontium fall-out from the stratosphere is stated to be very much faster. "The ethic of reverence for life is the ethic of love widened into Universality," says this great Man of Peace ; "a single H-bomb can destroy a million human beings," gloats the Cold Warrior. Man's survival in this planet depends upon which of the two attitudes to life will survive.

S. R. K.

Biochemical Society Symposia No. 15—Metals and Enzyme Activity. Edited by E. M. Crook. (Cambridge University Press, London N.W. 1), 1958. Pp. 102. Price 21 *sh.*

The symposium under review is a collection of the papers read and the discussions held in the Conference of Chemists and Biochemists at the University of Leeds in 1956 and has been edited for publication by E. M. Crook. An increasing number of enzymes have recently been found to require for their activity, trace elements such as zinc, molybdenum and the like, and every one will welcome the book for its comprehensive survey of our present knowledge in this field.

In the first paper, R. S. Nyholm has discussed the nature of the bond between metal atoms and the organic groups to which they are attached. The function of metal ions in enzyme systems has been discussed by L. E. Orgel and has been brought up-to-date in the light of recent findings. It is one of the best review articles so far written on the subject and is noteworthy for its critical analysis of the various possible types of interaction between metal ions on the one hand and substrate or enzyme molecules on the other. B. R. Rabin has an article on the significance of the metal peptide complexes in relation to proteolytic activity, and has discussed in it the earlier hypothesis on the subject put forward by E. L. Smith and I. M. Klotz.

Non-specific activation by metal ions has been dealt with by F. C. Happold and R. B. Beechey, with particular mention of the effect of sodium, potassium and ammonium ions on tryptophanase activity. Also in a very lucid account of the function of heavy metals, F. Bergel and R. C. Bray have referred to the role of such metals in oxidations catalyzed by Xanthine oxidase and other metallo-flavo proteins. In the concluding article, E. C. Slater has presented a well documented survey on hæmoproteins with special reference to cytochromes.

The book is well got up and is a very valuable publication dealing with the biological significance of metal ions. Its contents will appeal to a wide range of research workers, including inorganic and organic chemists, biochemists and specialists in the medical sciences.

P. S. SARMA.

Advances in Enzymology, Vol. XX. Edited by F. F. Nord. (Interscience Publishers, Inc., New York), 1958. Pp. vii + 488. Price $ 12.50.

The current volume of *Advances in Enzymology* is noteworthy for the breadth of its coverage and in keeping with its international character has contributors drawn from various parts of the world including the U.S.S.R. The topics reviewed in this volume include optical activity with reference to enzymic synthesis of optically active compounds occurring in nature, Kinetics of alcohol dehydrogenase—DPN interaction, Imidazoles in biological systems, Uridine diphosphogalactose, Substrate and mode of action of Neuraminidase, Components of the respiratory chain in animal tissues, Enzymology of the plastids, Transformations of steroids in micro-organisms, Mechanism of hydrolysis of choline esterase and related enzymes, Biosynthesis of dicarboxylic acids in plants, Pectic enzymes and their substrates and Antibiotics in plant pathology. The presentation in every case is well documented and is followed by a list of pertinent references. The book has a Foreword by the Editor who cites a few well chosen examples to illustrate the set-backs suffered in the development of new ideas by the operation of the personality cult in the scientific field.

Among the highlights in this volume, the article by Barnard and Stein entitled "The Roles of Imidazole in Biological Systems" is timely and fulfils a long-felt need for an extensive coverage of the literature on the imidazole, which is fast getting recognition as a group to be reckoned with, in explaining the catalytic activity of various enzymes. The imperative necessity for a group specific reagent for imidazole is stressed as also the various aspects of imidazole such as its chemistry, catalytic activity and chelating property. The essential nature of the imidazole group in the activity of choline esterase is also discussed at length by Davis and Green, drawing on the evidence obtained from Kinetic and inhibition studies on this and related enzyme systems.

The enzymology and biology of Uridine diphosphogalactose is reviewed by Kalckar and in this he also traces briefly the work carried out by his group on the etiology of the disease, "galactosemia".

The article by Slater entitled "The Constitution of the Respiratory Chain in Animal Tissues" is a critical appraisal of the claims of various compounds commonly considered as components of the respiratory chain. The picture of the respiratory chain as envisaged by this author is in broad agreement with the findings of the other research workers in this field except for the position of cytochrome 'b' which does not find a place in his scheme in the pathway of oxidation of DPNH in mitochondria. However, as emphasised by this author, the last word on the subject has not so far been said and the increasing tempo of research evident in this field may soon help to clear much of the uncertainties which exist at present in regard to the role of Vitamin K, α-tocopherol and related compounds as carriers in the respiratory chain.

Among other articles of interest, may be mentioned the one by Sissakian, who calls attention to the various biochemical functions the chloroplasts have, in addition to their role in Photosynthesis. The field of steroid transformations by micro-organisms is surveyed by Vischer and Wettstein mentioning in particular the ample opportunities for basic research which exist here for the enzymologist.

Though not entirely free from typographical errors, the book in its get-up and in the selection and treatment of topics comes up to the high standard, which one has come to expect of this annual collection of authoritative reviews in Enzymology.

P. S. SARMA.

Surgical Convalescence. By F. C. Dohan and others. (*Annals of the New York Academy of Sciences*, New York, Vol. 73, Art. 2), 1958. Pp. 381-538.

The process of recovery of a patient to the original normal working state after a surgical operation depends on physical, chemical, metabolic, psychological, social and economic factors.

This monograph has explored the factors influencing the total duration of the convalescent period after surgery and is quite an unique contribution to our knowledge of surgical convalescence.

The fifteen scientific papers forming the monograph represent extensive clinical studies and biochemical investigations undertaken to understand the various aspects of body response to injury. The observations and conclusions have resulted out of the scientific study conducted on Americans under conditions existing in United States. Whether the same observations would hold good for our patients here in India is to be investigated and studied.

The paper on physiological response of domestic animals during the immediate post-surgical period presents interesting features such as rapid convalescence and demonstration of spontaneous activity immediately after recovery from anæsthesia. This is in contrast to the response we observe among human subjects.

The need for a rehabilitation programme, particularly for those who have prolonged convalescence, has been rightly stressed. This will not only help the patients to get back to their working state earlier but also will minimize the boredom.

In content these papers reflect the surge of interest in research in the field of Surgical Convalescence.

H. K. Srinivasa Murthy.

The Basic and Clinical Research of the New Antibiotic, Kanamycin. (*Annals of the New York Academy of Sciences*, Vol. 76, Art. 2), 1958. Pp. 17-408.

Search for new antibiotics, less toxic, and capable of acting on the organisms which have become either resistant or are not inhibited by the antibiotics now in use, is going on at a fast pace all over the world. The claims of many of these have, within a short period of their introducing, found to be premature and exaggerated. In this atmosphere of scepticism, it is heartening to come across this volume, which presents a simple record of the investigations carried out on a new antibiotic, Kanamycin and leaves the reader to form his own opinion on the usefulness and efficacy of this antibiotic.

The Japanese workers, the original discoverers of this antibiotic, have reviewed their work on the isolation, development, properties and early clinical applications. The later researches, carried out mostly in the various laboratories of the U.S.A., have been very lucidly presented by the investigators. The aspects dealt with in the early chapters are chemistry of Kanamycin, microbiological and pharmacological studies, interrelationship of cross-resistance with other antibiotics and the efficacy of the antibiotic on experimental infections.

The latter half of the volume is devoted to the clinical experiences with Kanamycin in pulmonary tuberculosis, pyoderma, *Salmonella* and *Shigella* infections, surgical infections, staphylococcal epidemic in infants and clinical evaluation in resistant bacterial infections.

The basic and clinical researches of this antibiotic, its potential usefulness and limitations in clinical medicine have been very ably summarised in the concluding chapter by Finland and constitutes a critical unbiassed appraisal of the entire study on Kanamycin. M. Sirsi.

Vladimir Pokorny : Grundzüge der Zoologischen Mikropaläontologie Band 1. (Published by Veb Deutscher Verlag der Wissenschaften, Berlin), 1958. Pp. xii + 582. Price DM 48.

Dr. Pokorny's book on Micropalæontology published in 1954 in Czech (*Zaklady Zoologické mikropaleontologie*, pp. 652, Nakl. CSAV Praha, 1954) evinced great interest and micropalæontologists all over the world owe a debt of gratitude to the author for placing before them the present German edition which obviously will be read and understood by a much wider circle. Micropalæontology today has acquired much importance because of its ready application to stratigraphical problems in the oil industry. The available literature is vast and the groups that come under microfossils are ever on the increase. Marcus Hanna (Significant Advances and Trends in Geology—*Proceedings, 4th World Petroleum Congress*, Section I/D, Rome, 1955) pointed out that present-day palæontology is not mere descriptive palæontology but tries to understand and interpret what fossils mean with reference to the sediments in which they are found. There is no denying that all fossils, large or small, are useful. But microfossils being small tend to show a greater uniformity in character over wider areas and therefore have a special attraction to the palæontologist engaged in economic work. The "Grundzüge" under review is a more advanced text-book than the English "Principles of Micropalæontology" by Glaessner and covers not only the descriptive part of micropalæontology but also the various methods of preparing the sample, the choice of which again depends on the group of microfossils one wishes to study, photography of

microfossils, methods of correlation and the stratigraphic as well as geographic distribution of the various groups of microfossils. The author has taken note of recent researches in the field of Cretaceous-Tertiary boundary and has taken the top of the Maestrichtian as the end of the Cretaceous period.

The book is divided into 10 chapters, the first three of which deal with definition and concept of Micropalæontology; this is followed by a brief historical survey, collection and methods of preparation for the study of the various kinds of microfossils including special techniques, the use of ordinary stereomicroscope, polarizing microscope and electron microscope in the study of microfossils and methods of correlation, both local and regional. The groups of fossils described are the Protozoa (Radiolaria, Thekamœba, Foraminifera and Tintinnina), some organisms whose systematic position is not clear (Pithonella, Stomiosphæra, Cadosina and Oligostegina), Chitinozoa and Hystrichosphærids. A very welcome feature of the book is the numerous large and clear illustrations which are placed alongside the descriptions for easy reference.

Foraminifera naturally take up the greater part of the book. There are certain departures from the classification of Cushman as a result of more recent systematic studies bringing in a happy blend of the researches made in the USSR and allied countries as well as those from outside this sphere in Europe and America. There are minor taxonomic points in which fellow palæontologists may differ from the author, for example: the inclusion of the arenaceous forms Geinitzina and Spandelina in the typically calcareous group Nodosariidæ, the inclusion of Gumbelitria under Orbulinidæ while the related forms Gumbelina and Pseudotextularia are found under Heterohelicidæ. The treatment of Lenticulina under various subgenera is a point about which there are likely to be differences of opinion. In some cases the ranges of genera given do not conform to their known ranges. Some of the important examples are Siderolites (U. Cretaceous—Recent), Miscellanea (U. Cretaceous—Recent), Aktinocyclina (M—U. Eocene), Halkyardia (M. Eocene—Aquitanian). As far as the reviewer is aware Siderolites is restricted to the Maestrichtian, Miscellanea is typically Paleocene, Aktinocyclina is also known from Paleocene and Halkyardia is not known outside the Eocene. The author has included Calcarina as a synonym of Siderolites. This will probably be unacceptable to many palæontologists. Also certain genera like Somalina, Saudia and Fabiania have not been mentioned. These are but minor points and should not distract from the value of the book especially since the book is not exclusively dealing with Foraminifera.

Exhaustive references covering the subjects dealt with in the book, classified under different heads for easy reference, a general index, a taxonomical index and an author index are given at the end.

This is probably the best book on the subject and should prove to be an excellent reference book to both systematic and economic micropalæontologists. The book is well printed and the price is reasonable. It is hoped that the second volume covering Metazoa will be published early. There is no text-book on Ostracoda and this is one of the most useful groups for the economic palæontologist. This has been fairly well covered in the earlier Czech edition and it is hoped that the author will cover this group fairly well in his second volume.

Y. N.

Flowering Plants of Eastern India, Vol. 1. (*Monocotyledons.*) By J. N. Mitra. (The World Press Private Ltd., Calcutta), 1958. Pp. xx + 388. Price Rs. 30·0.

The *Flora of Assam* by Kanjilal *et al.* (1935-40) is the last important work on the Flora of a part of Eastern India, but leaves a series lacuna in knowledge owing to the non-inclusion of Monocotyledons of Assam except Gramineæ. Mitra's present volume dealing with the Monocotyledons of Eastern India is, therefore, a welcome addition to the knowledge of Botany of the region in general and those of Assam in particular.

The other merits of Mitra's volume are the presentation of the 35 monocot families of Eastern India in a classification of his own and the enunciation of a comprehensive 'key' for easy identification of the families, genera and species, which include a certain exotic monocot species introduced and cultivated in gardens together with their Bengali/vernacular names.

All the same the volume suffers greatly from an over-ambitious scheme which has been too hastily pursued and rapidly rushed through for publication.

The author's classification of the monocot families is claimed to be phylogenetic but it should have been accompanied with a critical analysis and the floristic divisions (p. xvi), followed by a discussion to be thought-provoking and acceptable.

Again, the entire monocot flora of author's 'Orissa' with the exception of Glumifloræ and

Orchidaceæ, has been represented by 6 species alone (*vide*, pp. 2, 21, 48, 51, 53, 64 in addition to the references to species occurring in whole of Eastern India). Similarly *Paleosanthes bakeri* Hkf., *Smilax quadrata* ADC, *Dioscorea prazeri* Prain & Burkill and *Oxytenanthera parvifolia* Brandis (*ex* Gamble from Assam) are a few of the large number of species collected and deposited in Shillong Forest Herbarium but not included in the present volume. The occurrence in Assam of a very large number of monocot species such as, *Ottelia alismoides* Pers, *Hydrilla verticillata* (Roxb.) Royle and many others described in the volume has not been noted at all. These avoidable omissions are presumably due to the author's not consulting the monocot species available in the former Shillong Forest Herbarium (now Shillong Regional Herbarium of Botanical Survey of India).

While the author has adopted the changes in nomenclature in many instances (*viz.*,—*Mondo*, p. 42, *Habenaria*, pp. 274-76, *Malaxis*, p. 294, *Murdannia*, p. 16), he has been almost oblivious of the many such changes in other genera and species. To quote a few, *Cyperus brevifolius* (Rottb.), Hassk (for *Kyllinga brevifolia* Rottb.), *C. globosus* Allion (for *Pycreus globosus* Reichb f.), *Ananas camosus* (Linn.) Merr (for *A. sativus* Schult f.) [*cf.* Santapau, "Flora of Khandala, etc.." in *Records of Botonical Survey of India*, XVI, (1), 337-Seq., 1953] Similarly, records of new species from Eastern India, such as, *Poa eleanoræ* Bor, *P. poophagorum* Bor in *Kew Bull.*, 1948, 142-143 (1948) and many others have not been included in the present volume, published in 1958.

A number of mistakes in spelling of technical terms, such as occur on pages 53, 143, 152, 155, 278, 312 and 349 could have been corrected in proof. The description of *Galeola falconeri* Hook f. (p. 284) is incorrect.

Despite these mistakes and omissions, however, the get-up and printing are good and the present volume is a definite contribution to the knowledge of Botany of the region.

G. PANIGRAHI.

Bird Hybrids : A Check-List with Bibliography. By Annie P. Gray. (Commonwealth Agricultural Bureaux, Bucks, England), 1958. Pp. viii + 390. (24·5 × 15·5 cm.). Price 50 *sh.* net.

A fundamental point in the modern concept of the species is that it should be reproductively isolated. Reproductive isolation between species is achieved in several ways : geographical or ecological separation, structural differences, physiological incompatibility where distributional ranges overlap, and others. Even though crossing between some strikingly different species is artificially possible, and occasionally occurs also in nature, the hybrids are normally either physiologically defective, or sterile, i.e., they are incapable of breeding *inter se* and thus perpetuating their intermediate characteristics.

The superficial morphology of hybrids is often quite confusing. The confusion is increased by the fact that in many birds the young differ so markedly from their parents in appearance and in others the sexual dimorphism is so great, that in the past young and old, or male and female have sometimes been ascribed to different species, or to the result of hybridization. On the other hand natural hybrids have often been attributed to new species. Descriptions of known hybrids were widely scattered in the literature of many countries and languages and references were difficult to find. Thus, to the serious aviculturist no less than to the taxonomer, the systematist and the scientific field ornithologist the present compilation in a single volume of all the published as well as unpublished, reports of bird hybrids should prove invaluable. It gives a concise history of most of the crosses recorded and furnishes useful suggestive data which have an indirect bearing also on genetics, courtship patterns and isolating mechanisms. The hybrids are grouped within families and are arranged alphabetically under the scientific names of the species involved. Under each species is given a full list of those with which it is said to have hybridized, or with which hybridization has been attempted. Thus, under *Anas platyrhyncha* (the Wild Duck or Mallard)—the progenitor of our domestic duck —hybridization with no less than 50 species is recorded, some belonging to widely distinct genera, *e.g.*, *Anser*, *Branta*, *Mergus*. The strangest report of all is of the hybridization in this duck with a Guineafowl ; the authenticity of this seemingly impossible cross is, however, mentioned as 'extremely doubtful'. Natural hybrids among the Anseridæ, particularly the ducks, are well known, and a number of such have been shot in India by sportsmen from amongst the migratory species. Other groups of birds in which hybridization is common are the Pheasants (Phasianidæ), Parrots (Psittacidæ), Humming Birds (Trochilidæ), Birds of Paradise (Paradisæidæ) and Finches (Fringillidæ). This may doubtless be due, in part, to the fact that these groups con-

stitute popular aviary birds which readily acclimatize themselves to captive or semi-feral conditions. Many species living in widely separated habitats are artificially brought together in avicultural collections and thus given opportunities of mating which are denied in the wild state. Nevertheless that hybridization also does occur on a large scale under natural conditions between sympatric species is shown by the fact that many Humming Birds and Birds of Paradise, formerly recognized as distinct species have been shown, on closer study, to be nothing but natural hybrids.

The comprehensive nature of *Bird Hybrids* and the magnitude of the task of compiling it may be gauged from the voluminous bibliography which covers 78 pages and includes over 1,900 titles. An index of scientific and vernacular names facilitates ready reference.

S. A.

Books Received

Recent Progress in Hormone Research, Vol. XIV. Edited by Gregory Pincus. (Academic Press, New York; India: Asia Publishing House, Bombay-1), 1958. Pp. v + 582. Price $ 13.50.

Handbook of Tropical Crop Disease. By M. N. Kamat. (Prakash Publishing House, 360, Budhwar Peth, Poona-2). Pp. 84. Price Rs. 2·50.

Modern Developments in Plant Physiology. Edited by P. Maheshwari. (Published by Botany Department, University of Delhi, Delhi-8), 1958. Pp. xi + 170. Price not given.

Electroanalytical Chemistry, II Edition. By J. J. Lingane. (Interscience Publishers, New York), 1958. Pp. xiv + 669. Price $ 14.50.

Mechanical Cultivation in India. By D. A. Gadkary. (The Publications Division, Civil Lines, Delhi). Pp. vii + 147. Price Rs. 7·25.

Dairy Microbiology. By E. M. Foster, F. E. Nelson, M. L. Speck, R. N. Doetsch and J. C. Olson, Jr. (MacMillan & Co., St. Martin's Street, London, W.C. 2), 1958. Pp. xvi + 492. Price 42 *sh*.

Principles of Electronics, II Edition. By H. Buckingham and E. M. Price. (Cleaver-Hume Press Ltd., 31, Wright's Lane, Kensington, London W. 8), 1958. Pp. 419. Price 17 *sh*. 6 *d*.

Practical Invertebrate Anatomy, II Edition. By W. S. Bullough. (MacMillan & Co., St. Martin's Street, London W.C. 2), 1958. Pp. xiv + 483. Price 30 *sh*.

Robert Boyle and Seventeenth-Century Chemistry. By Marie Boas. (Cambridge University Press, London N.W. 1), 1958. Pp. vii + 239 Price 30 *sh*.

Reflex Klystrons. By J. J. Hamilton. (Chapman & Hall, London W.C. 2; India: Asia Publishing House, Bombay-1), 1958. Pp. xi + 260. Price 45 *sh*.

Third Tissuehomotransplantation Conference. By J. M. Converse, B. O. Rogers and others. (*Annals of the New York Academy of Sciences*, New York, Vol. 73, Art. 3), 1958. Pp. 538-868.

Enzymes in Blood. By L. P. White. (*Annals of the New York Academy of Sciences*, New York, Vol. 75, Art. 1.) Pp. 1-384.

Perspectives in Marine Biology. Edited by A. A. Buzzati-Traverso. (University of California Press, Berkeley; Cambridge University Press, London N.W. 1), 1958. Pp. xvi + 621. Price 75 *sh*.

Transport Processes in Statistical Mechanics. Edited by I. Prigogine. (Interscience Publishers, New York), 1958. Pp. x + 436. Price $ 10.00.

Advances in Chemical Physics, Vol. I. Edited by I. Prigogine. (Interscience Publishers, New York), 1958. Pp. xi + 414. Price $ 11.50.

Organic Syntheses with Isotopes, Part II. By A. Murray and D. Lloyd Williams. (Interscience Publishers, New York), 1958. Pp. ix + 2096. Price $ 25.00.

Theories of Figures of Celestial Bodies. By W. S. Jardetzky. (Interscience Publishers, New York), 1958. Pp. xi + 186. Price $ 6.50.

Rational Simplifications for the Buckling Length of Columns. By T. C. Kavanagh. (*Annals of the New York Academy of Sciences*, New York, Vol. 72, Art. 2), 1958. Pp. 353-386. Price $ 2.50.

The Theory and Design of Magnetic Amplifiers. By E. H. Frost-Smith. (Chapman & Hall, London, W.C. 2; India: Asia Publishing House, Bombay-1), 1958. Pp. xix + 487. Price 75 *sh*.

Essential Oils and Aromatic Chemicals—A Symposium. (The Publications Division, C.S.I.R., New Delhi), 1958. Pp. xx + 174. Price Rs. 10·00.

Andhra University Memoirs in Oceanography, Vols. I & II. (The Registrar, Andhra University, Waltair), 1958. Pp. 161 and 237. Price Rs. 15 each.

SCIENCE NOTES AND NEWS

Award of Research Degrees

The University of Poona has awarded the Ph.D. Degree in Chemistry to Shri M. V. Kaulgud and Smt. M. V. Natekar for their theses entitled 'Ultrasonic Velocity in Liquids and Liquid Mixtures' and 'Alcoholysis of Oils and Fats' respectively and the Ph.D. (Agri.) Degree to Shri M. C. Srinivasan and Shri S. K. Dorge for their theses entitled 'Studies on Some Phytopathogenic Bacteria of Bombay' and 'Land Crab Control with Insecticides' respectively.

Andhra University has awarded the D.Sc. Degree in Zoology to Shri C. C. Narasimhamurti for his thesis entitled 'Studies on Protozoan Parasites from Myriapoda and Insecta'.

"ENDEAVOUR" Prizes

The Imperial Chemical Industries Limited (Publishers of the Quarterly Scientific Review, *Endeavour*, have offered prizes totalling 105 guineas for essays submitted on scientific subjects. The competition is restricted to those whose twenty-fifth birthday falls on or after 1st June 1959. The first and second prizes are of value 50 and 25 guineas respectively. Two special prizes of 5 guineas each will be awarded for competitors who have not passed their eighteenth birthday on 1st June 1959. The subjects for the essays are as follows: (1) New Sources of Power, (2) Transport in the Modern World, (3) The Exploration of Space, (4) The Mechanism of Inheritance, (5) Enzymes, (6) Man-made Fibres.

An additional prize of 20 guineas will be awarded for an essay on any scientific subject of a candidate's own choice.

In addition to the cash prizes, the prize winners will receive invitation to attend the British Association Meeting at York, from 2-9 September 1959.

Essays should be in English and typewritten, and should not exceed 4,000 words in length. Only one entry is permitted from each competitor. The essays must be submitted without signature. The competitor's full name and address and date of birth should be disclosed in a sealed covering letter attached to the essay. All entries should be addressed to the Deputy Secretary, British Association for the Advancement of Science, 18 Adam Street, Adelphi, London W.C. 2. The envelope should be clearly marked "Endeavour Prize Essay". The latest date for receipt of entries is 1st June 1959.

Helium as Rocket Fuel

Helium is normally thought of as an inert and chemically useless gas. But in a special state, it is theoretically the best possible store of chemical energy for rockets. The required state of helium is that known technically as $2\ ^3s$. It is produced by subjecting cold helium to radio waves of the appropriate frequency. It is unstable at normal temperatures, but at temperatures below about $-200°$ C. it has a precarious stability.

At 4° above absolute zero it forms a solid in the presence of hydrogen. Helium $2\ ^3s$ should behave chemically like lithium (a very reactive metal) and apparently combines with the hydrogen to form helium hydride.

The effectiveness of a rocket fuel is measured in terms of specific impulse, the time for which one pound of fuel will deliver one pound of thrust before it is exhausted. Present-day fuels have specific impulses of about 300 sec.; helium $2\ ^3s$ has a theoretical specific inpulse nearly ten times as great, 2,900 sec. Helium hydride is not much inferior, at 2,400 sec.—*The New Scientist.*

New Method of Exploring Atomic Nucleus—Bombardment by Heavy Ions

A new way of exploring the atomic nucleus has been suggested by Prof. Vitaly Goldansky of the USSR Academy of Sciences.

It is known that atomic nuclei have 'shells' consisting of nucleons which can shift from one shell to another, thereby altering the internal structure of the nucleus. It may be presumed that other and still more delicate phenomena can occur in the nucleus—the shifting of nucleons inside the shells proper, producing the hitherto unknown energy levels. The detection and identification of the phenomenon will provide a great deal of interesting data on the structure of the atomic nucleus.

Prof. Goldansky believes, however, that this cannot be effectively studied by ordinary means, i.e., by bombarding the nuclei with elementary particles or the simplest nuclei. When hitting the target nucleus, these particles bring in an excess

dose of energy, which in most cases destroys the nucleus instead of changing its structure. He suggests that in order to make protons and neutrons "shift" within the shells the nuclei should be bombarded with heavy ions (atoms stripped of some of their electron shells) at a low energy at which they are hardly likely to fuse with the target nucleus. Such interaction can lead to a neutron "exchange" and to an alteration in the nucleon interaction inside the nuclear shells. Prof. Goldansky believes, the changes involved can easily be observed by the gamma rays emitted by excited nuclei. This method of nuclear investigation will be one of the most delicate methods of affecting the structure of the atomic nucleus.—*Science Newsletter.*

Tubing as Thin as a Human Hair

Microtubing so small that it compares in diameter to a human hair, yet has many desirable properties for industrial applications, will be produced by a large American chemical company.

Tentatively named Santotube Q, the tubing which is made of quartz, will be three thousandths of an inch in diameter. It is so tiny that it would take 40 miles of the tubing to weigh one pound and a 50-foot length to hold a single drop of water. It is so flexible that it can be tied in knots, has a greater tensile strength than steel, is resistant to high temperatures, is highly inert to chemicals and is a non-conductor of electricity.

The tubing was originally developed by the company's research scientists in fibre form for the Atomic Energy Commission. It is now available to industry, and is expected to play a prominent part in a new development for recovering large quantities of helium, now lost annually in natural gas.—*SACSIR Science News Selections.*

Fluorescent Area Light

Westinghouse scientists are producing fluorescent light in large, thin, rectangular glass plates no more than an inch thick.

Representing a major change in design from the conventional fluorescent tube or line source of light, the unusual lamps consist of a labyrinth or maze of passages sealed in a thin glass block. The arc or electric discharge travels in a winding path through the glass block to produce, in effect, a large area source of light.

Typical models now in the laboratory measure 24 inches long by 8 inches wide by 1 inch thick, and 12 inches square by 1 inch thick. There are also models with a reflector on one side so that all the light can be reflected through a single side of the lamp.

Because the new fluorescent lamps require a fixture with practically no depth, they can drastically reduce the amount of ceiling space required to mount the lamps. Square-shaped lamps could be used as glass bricks or tiles in ceilings, walls and floors. Extensive future applications are foreshadowed for this new lamp. These fluorescent area light sources are not presently scheduled for production.

Holes of Negative Mass in Germanium

In semiconducting materials such as germanium currents are carried not only by electrons (negative charge) but also by "holes" (positive charge) which can be thought of as electron deficits in the crystal that can be transferred from one point to another, but in fact seem to have more reality than this picture may suggest.

Workers at the RCA Laboratories, Princeton, have studied the absorption of ultra-high-frequency radio-waves in germanium subjected to a magnetic field at very low temperatures and have found new evidence for the existence of holes of negative mass. There is a reduction in the absorption at certain values of the magnetic field where the holes of presumed negative mass resonate with radio-waves, meaning that the current-carriers lose energy—rather than gain it, which is usual in an absorption process.—*New Scientist.*

Silicon Solar Cells

These cells are a device to convert sun's rays directly into electrical power.

The U.S. Vanguard satellite, still circling the Earth, has been equipped with 108 cells located in six clusters placed symmetrically around the sphere's surface to convert sunlight of outer space into electrical power which operates one of the satellite's radio transmitters.

Solar converters are wafer-thin discs of extremely pure silicon fused with minute amounts of arsenic and boron, which create the electron groupings that provide positive and negative electrical fields. After etching, plating and testing the cells are joined in series of various sizes and shapes to meet requirements of specific applications. Light photons penetrating the silicon cause the flow of electrons and result in a voltage build-up within each silicon cell. This converted energy is then conducted to whatever outlet has been provided.

The world's first commercial solar cell panel, a 144-cell modular assembly made by Hoffman, Electronic Corporation, is designed to supply electrical power in multiples of five watts. Remote areas without electrical power sources may rely on a system of these modular units for constant power.

Silicon solar cells have an estimated life-time of many years, do not deteriorate and are virtually unaffected by humidity and temperature variations. They also convert incandescent light into electricity.

Silicon solar converters made to-day have a top efficiency of about 10%. While not far enough developed at the present time to compete economically with high voltage electrical power, the converters are considered ideal for supplying low-power requirements in lieu of heavy, generated electricity.—*J. Frank. Inst.*, October 1958.

Thin Films of Glass for Electrical Devices

Extremely thin films of glass which can be used to make synthetic mica for electrical insulators and "rugged" electrical condensers have been produced by some Russian workers. The films are made by forcing molten glass through a narrow slit in the bottom of a melting vessel. The falling ribbon of glass that emerges is stretched and thinned by pulling it on to a rotating drum, the thickness of the film being controlled by adjusting the speed of rotation. Widths up to 4 inches and constant thickness in the range 0·0002-0·002 inches can apparently be obtained. Such thin film of glass are perfectly pliable and, since the melt is continuously replenished, long strands can be wound on to the drum. Various glasses can be treated in this way: among the compositions studied are lead and borosilicate glasses.

It is reported that synthetic mica was prepared by stacking short pieces of film to the required thickness. After moistening, the stack can be moulded under light pressure to form any desired shape which, after drying, will be permanently retained as the films are held together by the attraction between the molecules. The electrical properties of this artificial mica are similar to those of the natural kind. Experiments along similar lines were reported by an American worker in 1946. The Russians, however, seem to have taken their process to a stage where it can be exploited industrially.

The condensers consist of laminations of thin copper foil alternating with glass film, which are heated to the softening point of the glass when the film fuses to the copper to yield a solid block. The condensers have a high capacitance per unit volume and are naturally stable under extremes of temperatures and humidity. It is claimed, moreover, that the process lends itself to mechanisation much better than the method of making orthodox mica condensers.—*New Scientist.*

Cryopumping for Production of High Vacuum

Cryopumping is a new technique for the production of high vacuum. In principle the method consists in freezing all of the air in an enclosed chamber to a solid, thus leaving a high vacuum in it. It is being successfully employed by the Missile Research Laboratory of the University of Southern California to simulate, in their Hypersonic Wind Tunnel, conditions obtained at very high altitudes in the atmosphere.

The cryopump is an extreme low temperature refrigerator, using helium gas at —420° F. as the refrigerant. At present it is most efficiently used in conjunction with mechanical pumps. Low pressures of the order of 10^{-4} mm. can easily be produced with the cryopump.

In the Hypersonic Wind Tunnel, instead of blowing or pulling air over the test models by conventional means, which would require pumps and fans and occupy large space, the cryopump freezes nitrogen gas out of the stream at one end, causing a flow of nitrogen from the other end of the tunnel and over the objects being tested. Nitrogen is used instead of air to eliminate the need to remove moisture from the gas stream. The temperatures of the tunnel at the cryopump end is around —450° F. In order to duplicate high temperature conditions under which missiles would operate at high speeds, the nitrogen gas is heated electrically on its entrance into the tunnel and again just before it flows over the models. After the nitrogen passes over the models, it is drawn on to the large metal plates of the refrigerator, where it condenses and freezes.

Missiles placed in the tunnel can thus be tested as though they were flying at 20 times the speed of sound and nearly 60 miles above the earth.

The USC Tunnel is unique in that its only moving parts are in the refrigerator, which runs on a 50 H.P. motor. A comparable unit based on a gaseous diffusion pump would require 500,000 H.P.—*J. Frank. Inst.*, January 1959.

Origin of Chemical Elements

The interaction of elementary particles with heavy elements is one of the main problems of contemporary physics the solution of which will help in the development of a comprehensive theory on the atomic nucleus and the origin of elements. Soviet experiments with the proton synchrotron have shown that by irradiating hafnium, the element next to the rare elements in the periodic table, with a flux of accelerated elementary particles of energy up to 660 Mev., it has been possible to obtain light isotopes of a number of rare elements. Light isotopes of rare elements have also been created by splitting uranium.

These experiments prove the possibility of formation of lighter elements out of heavy elements as a result of interaction with particles of energy much less than the energy of cosmic rays. This leads to the view that one of the most probable ways of element formation is the action of cosmic rays upon atomic nuclei. In the conditions of a plasma ball which possibly preceded the formation of earth, intensive neutron fluxes might have played the role of cosmic rays.

This process is especially intensive in meteorites. The latest studies of meteoritic matter had discovered traces of the splitting of iron, calcium and other elements.—A. Vinogradov: *USSR News.*

Origin of Solar X-Rays

Rocket observations of the solar eclipse of October 1958, undertaken by U.S. as part of the IGY programme, help to locate the region of the sun's atmosphere in which solar X-rays originate.

Five rockets were fired before, during and after the eclipse from a ship off the Danger Island in the Pacific. Four of them reached the required altitudes of 139 to 150 miles. Data telemetred back from the rockets indicated that as the surface of the sun was obscured by the moon, ultraviolet radiation diminished but the intensity of X-rays was unaffected. These observations seem to confirm the belief that whereas the ultraviolet radiation comes from the lower part of the sun's atmosphere or the chromosphere the X-rays originate in the sun's outer atmosphere or the corona.—*UNESCO, No. 326,* March 9, 1959.

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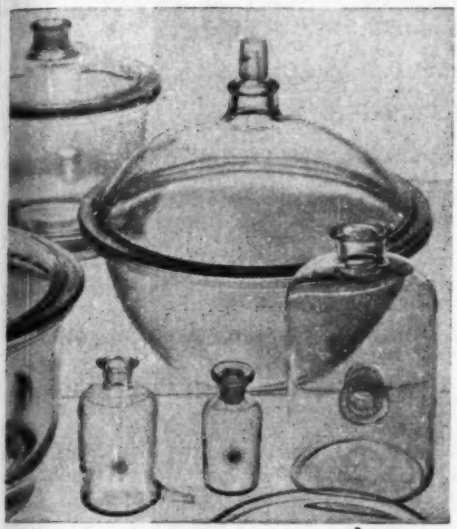

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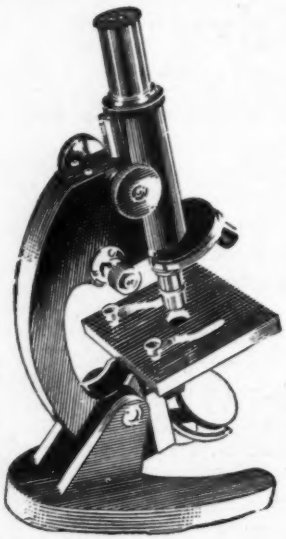

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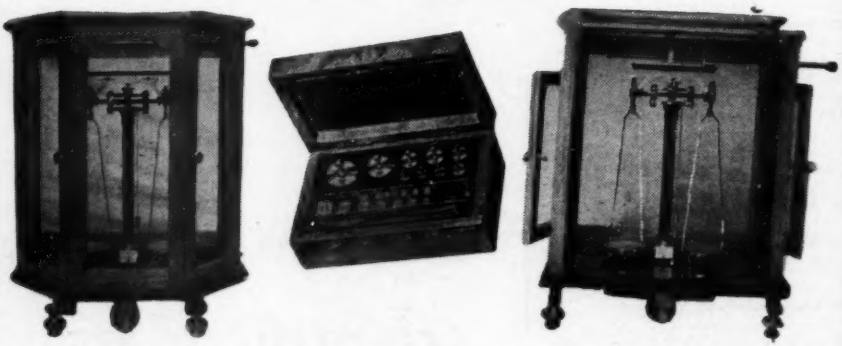

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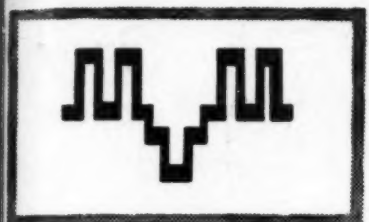

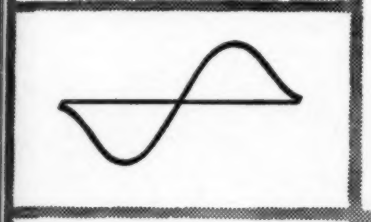

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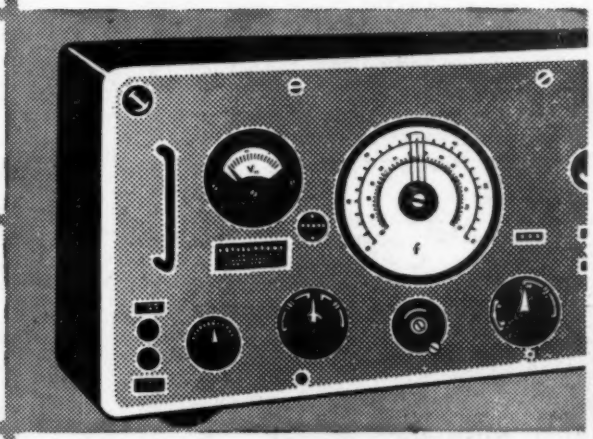

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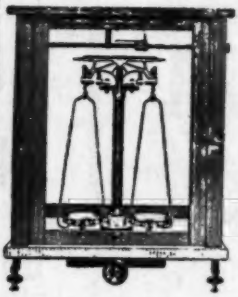

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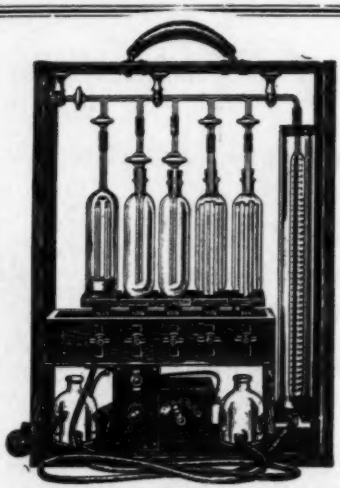

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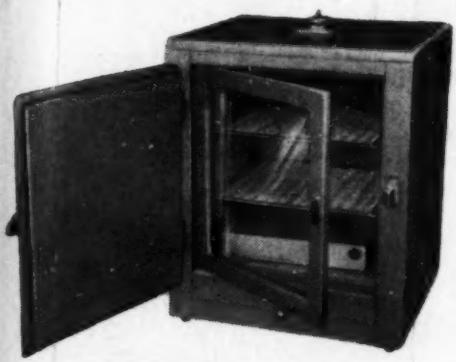

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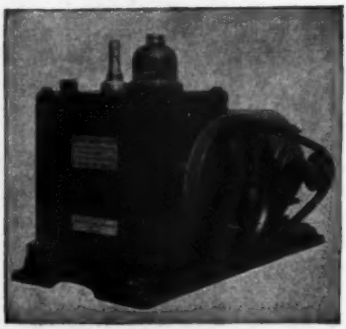

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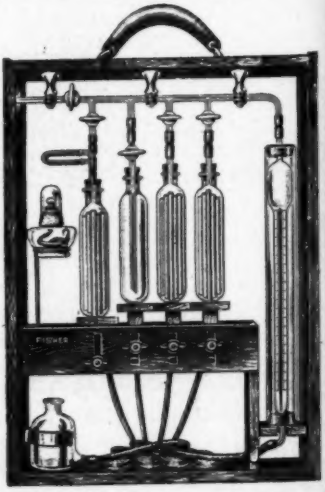

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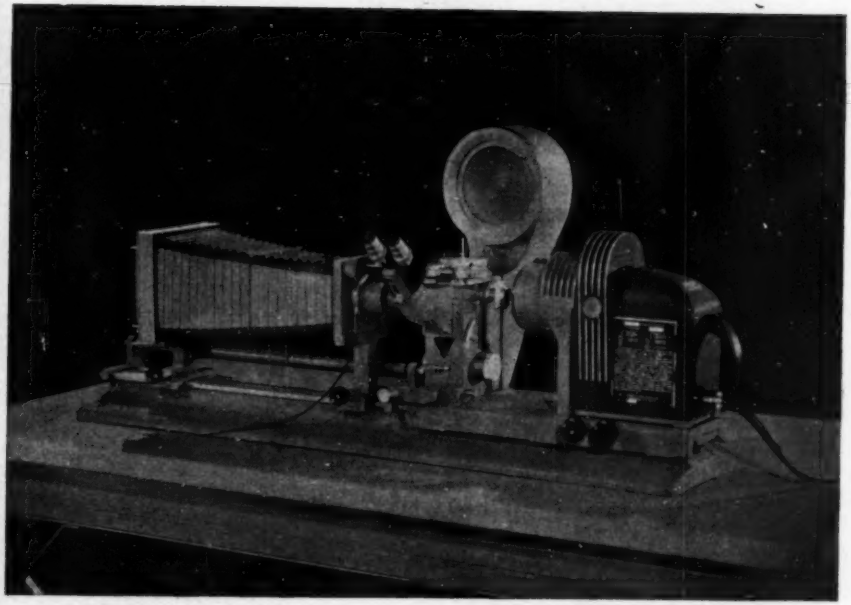

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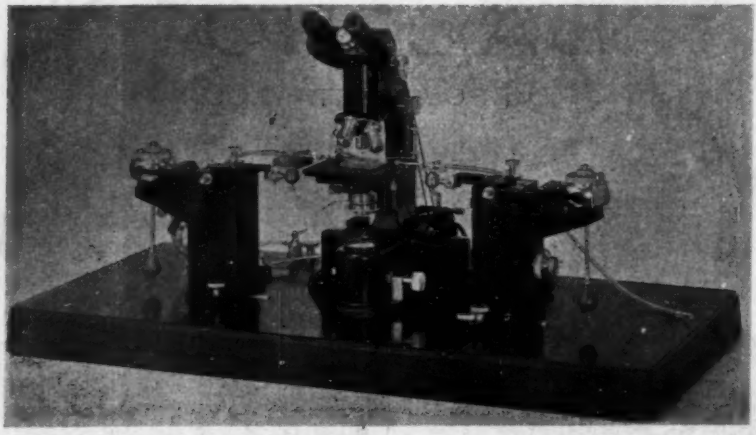

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